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ABSTRACT

This book is designed to help a Technology Advisory Council (TAC) get a start at helping children obtain a better education--an education that prepares them for adulthood in an information age society. The advisory council is a representative group of stakeholders, i.e., the people who are affected by decisions and those involved in implementing the decisions. This book provides a sense of direction for some things that a TAC might do once it is started. The book is divided into 10 chapters: (1) The Electronic Classroom; (2) Overview of Computers in Education; (3) Building a Technology Advisory Council; (4) The Strategic Planning Process; (5) Gathering Baseline Data; (6) Megatrends: Computers in Education; (7) Current and Future Technology; (8) Goals for Computer Technology in Education; (9) Staff Development as a Change Agent; and (10) Final Remarks. The appendices include letters which provide background information to stakeholders; a number of funding sources that can help a school increase its uses of technology; a network of contact people, places, and projects; an annotated list of some fundamental readings; and a list of videos that can help TAC members and others learn about educational uses of computers. A glossary of key terms is included. (TMK)

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# The Technology Advisory Council: A Vehicle for Improving Our Schools

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*A good author possesses not only his own intellect, but also that of his friends.*

*Friedrich W. Nietzsche*

This book was produced by the cooperative efforts of educators participating in a Frontiers of Computers in Education course at the University of Oregon in the summer of 1992. Several of the authors continued work on the book during the fall of 1992.

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# Preface

*Man is a tool-using animal.*

*Thomas Carlyle*

Computers are here to stay. This is a trite, but true, statement. The newspaper, magazine, and television ads for computers give an indication of how large the computer market has become. It is evident that computers are becoming a common household item. They are routinely used throughout business, industry, government, education, and research.

At one time the word *computer* meant a person who carried out calculations using a desktop mechanical or electrically powered calculator. After the electronic digital computer was developed during the 1940s, the term *computer* gradually came to mean a *machine* rather than a *person*.

In this book we use the word *computer* to include both the electronic digital computer and the wide range of multimedia equipment such as the CD-ROMs and videodisc players now commonly used with computers. And, of course, a computer system includes a wide range of software and storage media.

Computers are a powerful tool. They are becoming more powerful every year as progress occurs in making faster circuitry, larger memories, better software programs, and better multimedia equipment. The price-to-performance ratio of computers is improving quite rapidly. That is, each year new computers have more muscle for the same cost as older models.

Computers are both a very complex and a very simple tool. Here are four "simple" uses of computers. A computer can help people to:

1. Access and store information.
2. Communicate.
3. Solve problems.
4. Learn.

Notice that all of these things are important in education! It is not surprising that almost every school now has some computers. Almost every student now learns "something" about computers. It is evident that most people consider computers to be an important part of education.

However, few schools have adequate modern computer facilities. In most schools, the curriculum does not adequately reflect the current capabilities of computers. Most teachers are not yet comfortable in integrating computers into their classrooms.

Most important, students are not learning very much about using computers. They are not being adequately prepared to deal with the (now) routine use of computers on the job or in postsecondary education.

The goal of this book is help our children obtain a better education—an education that prepares them for adulthood in our Information Age society.

There is a strong movement toward "site-based management" in schools. This means that more decision-making authority is being given to the people who have to implement the decisions and to the people who are affected by the decisions. It is a bottom-up approach to education, as opposed to a top-down approach.

Advisory councils are a key part of site-based management. An advisory council should be broadly representative of the stakeholders—the people who are affected by the decisions that need to be made and the people who are involved in implementing the decisions. Thus, an advisory council for computer technology in schools might well include students, parents, teachers, school administrators, school board members, taxpayers, business people, union representatives, and elected officials.

This book is designed to help a Technology Advisory Council (TAC) get started. It provides a sense of direction for some things that a TAC might do once it is started.

It is easy to get people to agree that children need a good education and that there is vast room for improvement in our current educational system. However, each person has his or her own ideas on what makes up a good education. Thus, there will be considerable disagreement among the members of a TAC. Nevertheless, the goal of helping children get a good education is so important that these disagreements can and must be overcome.

Computers *are* here to stay. They are changing our world, and they will change education. Every school or school district needs a TAC to help in planning and making the needed educational changes.

The Authors

January 1993

ABCD
abcd
Once upon a time, there were three bears
CS92

# Chapter 1
# The Electronic Classroom

*Revolutions never go backwards.*

*Ralph Waldo Emerson*

*In early 1936, I recognized a great desire within myself that could no longer be repressed. I wanted a typewriter.*

*Isaac Asimov*

This is a book for students and parents, for educators and taxpayers, for school board members and business people. Every once in a while the book uses "educationalese"—words that educators like to throw around but that few others understand or appreciate. At the end of this book, a Glossary of Key Concepts defines some of the educationalese used here. You may want to browse through it now or refer to it from time to time.

The Preface provides a good introduction to this book. If you skipped over the Preface, you may want to go back and read it. Then continue reading here, where you will find some glimpses into the future.

## Scenario

It is the year 2000 and you are one of the members of the Technology Advisory Council (TAC) visiting Jackson Middle School. The TAC has been instrumental in helping the school implement a number of changes designed to prepare students for adult life in our Information Age society.

It is mid-morning as you check in at the main office of the school and then begin to wander down the hallway looking for the right rooms. You notice a lot of students in the hallway; some are talking in groups as they work with laptop computers, some are looking through the wastebaskets, and a couple are using camcorders. One camcorder group asks you if you would be willing to be interviewed on the issue of pollution.

You say "yes" and quickly find yourself on camera. The students ask you some difficult questions, such as whether you are careful about recycling and whether you would be willing to pay a little extra in taxes to

allow the city to build a new recycling facility. You are impressed that middle school students are asking such thoughtful questions.

After you escape from the interviewers, you are met by Ms. Kay, who explains that she is one of a team of teachers working with a group of about 150 students in grades 6-8. She explains that the students spend a lot of time working in teams studying some very hard problems. "For example, this term we are studying global pollution," she says. "Each team of four students will spend about two hours a day for the next nine weeks on this topic. You probably encountered some of these students in the hallway. I think you will be interested in listening to the discussions of a few of the groups."

Ms. Kay directs you to a group of students talking about acid rain. One student asks, "Where does the acid rain come from that falls on Albany, New York? Are factories in Chicago, Illinois, responsible?" Another student responds, "I think some of it comes from Canada. That makes it an international problem." Pointing to a computer screen, the student asks, "See how the wind seems to flow across the top of Canada and then down into Albany?" A third student comments, "How can we tell how much of the pollution comes from different places? We'll need to do some math on this."

Ms. Kay points out that the students are brainstorming questions and are beginning to form hypotheses about possible answers. She introduces us to the students, and we learn that there are two eighth graders and two sixth graders on the team.

An eighth-grade students suggests, "We can get data on pollution from lots of cities and put it on our computerized weather map. That way we can see where the wind blows the pollution."

A sixth grader responds, "Yeah, but the winds are different in summer and winter. Is the pollution the same all year round?"

A third student suggests, "We can make animated maps for winter and summer. We can calculate the amount of pollution coming from the factories and the amount of acid rain in Albany. We can show all this on our computer."

A fourth student says, "Right. And we can make a computer presentation on what we find. Cool!"

Ms. Kay directs you to another group. They are talking about the same problem, but their approach is different. Mary, a tall seventh grader, says, "We need to convince adults that there is a problem. I think we need to get on TV."

"Far out!" another student says. "We could make a videotape that shows how bad the problem is. I'll bet the TV station will show it."

A third students suggests, "I really like to use the camcorder. And John is good at making computer music. John, could you make music that sounds like pollution?"

John replies, "I don't know. What's the sound of pollution? Maybe it sounds out of tune or sort of weird. I'll need to try out some ideas on the synthesizer. And maybe Mary can draw some pictures for us."

This discussion continues as Ms. Kay leads you to still another group discussion. The group is using a computer simulation of a garbage dump. In this simulation the students have to make decisions about where to locate a new garbage dump or find other ways to deal with the garbage.

One student says, "So, it seems we agree. The real problem is that people generate too much garbage. They need to recycle more."

A second student replies, "So we'll write a book on things that kids our age can do to stop making so much garbage. We can sell copies and make a lot of money."

A third students says, "No, I don't think that will do any good. Who would read it? We need to develop some hypermedia. We could go to the dump, get some good video, and interview some people there. We can use the video projector when we do our class presentation."

A fourth student replies, "Yuk! I've been there and it really stinks. I'd rather read about pollution. I want to do a computer search on the topic."

The discussion continues until the students decide what each of them will do first.

## How Has Technology Changed the Classroom?

Ms. Kay leads you through several rooms where groups of students work together. You notice that adults are helping some of the groups. Ms. Kay explains, "We have five teachers and two instructional assistants working together. We also have some adult volunteers. The student groups can always get some help from an adult if they really need help. But we want the students in a group to depend on each other. We want them to make decisions and be responsible for themselves."

"After all," she says, "In the real world people need to work together to solve problems, and they don't have teachers who know all the answers. The teachers in our team have learned how to answer questions

by asking questions. The goal is to help the group members figure it out for themselves."

Ms. Kay goes on to point out that students are using computer technology to get access to information and to prepare reports. "Some of the students like to draw pictures and compose music," she says. "Others like to use the camcorder. Every group must produce a final report—a report that they feel is useful to themselves and to others."

It occurs to you to ask how students are graded. Ms. Kay indicates that a variety of methods are used to determine grades. Students receive scores from the others working in their group. The teachers score each group and each student on how well he or she follows guidelines and meets deadlines. Individual students are evaluated on the contributions they make to their group's project and their component of the presentation. "We use performance assessment. We are interested in having students learn to work in groups, with each contributing in areas of their own interest," she explains.

## The Technology Advisory Council

There are many different groups of people who are interested in education. We call these groups "stakeholders." Parents are important stakeholders. They want their children to get a good education. Teachers are stakeholders who devote their professional careers to helping students learn. Business people are stakeholders, because they hire people who are educated in our schools. And, of course, students are stakeholders. It is their education we are talking about.

It is easy to make a long list of stakeholders—groups of people who may have differing views about certain aspects of our educational system. These differing views are important. Do you think a union representative thinks about computers in schools in the same way as a parent, a principal, a curriculum developer, or a student? Do you think a superintendent thinks about computers in schools in the same way as an unemployed school dropout, a state legislator, or a college professor? Such diversity is important; differing points of view must be carefully considered as schools make more use of computers.

This book is written for stakeholders. It is designed to help a group of stakeholders organize themselves into a TAC. A TAC can make a significant contribution to improving education. Appendix 1 identifies eight different categories of stakeholders and suggests some things that each can do to improve education. Appendix 1 consists of a sequence of short letters—one letter to each stakeholder group.

Every school and school district faces the problem of deciding how computers and other technology are to be used. A TAC will need to consider many different questions. Here is a short list of the types of questions that a TAC may want to address. Some may not pertain to your situation, and you will easily think of other questions to add to the list.

1. At what grade levels is it best to have students begin to learn to use computers?

2. Do all teachers, or just "computer" teachers, need to know how to use calculators and computers?

3. How should computer technology affect the content of noncomputer courses, such as reading courses, social studies courses, health courses, art courses, and so on?

4. How can we measure if students are learning the "right things" about computers and their uses?

5. Computers cost a lot of money. What is a cost-effective approach to helping students learn about computers?

6. Do we really need to make a lot of changes in our schools in order for our students to learn how to use computers? What role might computers play in the redesign and restructuring of curriculum content and pedagogy so that school is better?

7. Technology is changing very fast. How can our schools keep up (or should we even try)?

8. If students learn to use computers, will it help them get better jobs? What should our schools emphasize about computers if the goal is to help students get better jobs?

## Closing Remarks

This chapter began with a scenario—a picture of a middle school of the future in which a team of teachers, instructional assistants, and volunteers work with teams of students. Technology assists the students as they work on hard, interesting, and important real-world problems. A few of today's schools already function in this manner. Others use a lot of technology, but still use "traditional" instructional techniques. Still others put a lot of money into technology, but the facilities are used so poorly that the money is mainly being wasted.

It is evident that schools will use a lot more technology in the year 2000 than they use today. There will be many other changes. Team teaching, cooperative learning, and authentic assessment are likely to be a

routine part of the future. Team teaching supports students working on interdisciplinary projects. It also helps teachers have more time to learn new things and to develop new instructional materials.

The purpose of a TAC is to help provide leadership in improving education through appropriate use of technology. This book is designed to help a TAC get started. It suggests possible directions for school improvement, but it does not contain "the answer." Each school and school district will need to work out its own answers to the types of questions listed in the previous section.

This book contains five appendixes and a glossary. Each contains a great deal of information of potential value to a TAC. Before going on to the next chapter, you may want to browse through the appendixes and glossary.

Appendix 1. Letters to Stakeholders. These eight letters provide background information to eight different categories of stakeholders and suggest what each stakeholder can do to improve our educational system.

Appendix 2. Sources of Funding for Technology. This appendix identifies a number of funding sources that can help a school increase its uses of technology.

Appendix 3. People, Places, and Projects. A TAC needs to build a network of contact people, places, and projects. This appendix can be a useful starting point in networking.

Appendix 4. Recommended Readings. This is an annotated list of some fundamental readings that can help the TAC do its work.

Appendix 5. Video Resources. This is a list of videos that can help TAC members and others learn about educational uses of computers.

Glossary of Key Concepts. The glossary provides a list of words commonly used in the current pedagogy surrounding school change; some might be called "buzz words" in education.

KNOWLEDGE
INFORMATION
DATA

# Chapter 2
# Overview of Computers in Education

*The art of being wise is the art of knowing what to overlook.*

*William James*

Each reader of this book has some knowledge of computers and of possible roles of computers in education. Most likely, however, no two readers have the same knowledge. The purpose of this chapter is to begin to build a common core of knowledge. This will help support communication among the stakeholders serving on a TAC.

## The Computer as a Tool

Think about a computer as a general purpose tool—as an extension to the human mind and body. In many different jobs and in many different school subjects, a person who is skilled at using this tool has a great advantage over a person who does not know how to use the tool. The computer user can accomplish more work in less time. The computer user can solve some hard problems that cannot easily be solved without the use of a computer.

The computer is both a very simple tool and a very complex tool. It takes only a few minutes of instruction and practice to learn some uses of a computer. For example, very young children easily learn to use a computer to practice some of the things they are learning in school or to play a computer game. However, it takes quite a bit more work to learn to use a computer as a precise drawing tool, as an aid to composing music, as an aid to solving science problems, or as an aid to solving business problems.

Computers are a very rapidly changing tool. A 20-year-old computer may occupy a prominent place in a computer museum! A $2,000 computer of today may be several hundred times as fast as (and, in many other ways, better than) a similarly priced machine of 20 years ago. Twenty years from now, people will likely be making a similar statement about computers. Our educational system must deal with this very important and rapidly changing mind tool.

## Some Key Questions

As computers become less expensive and more readily available, educators must deal with three basic issues:

1. Improving education by empowering students and teachers—Technology empowers its users. In what ways is our overall educational system improved by providing students and teachers with good access to computers and other information technology facilities, along with good education on how to make use of these facilities? There are many subquestions under this main heading. For example, how can teachers provide useful feedback to students who are working in a hypermedia environment, and how can teachers adequately assess this type of student work?

2. Learning about technology—What should students learn about computers and other information technology and in what context should they gain this knowledge? For example, should all students be required to take a "computer literacy" course, and should we assume that successful completion of such a course adequately prepares a student to deal with computer-related technology?

3. Learning to learn—How can computers and other information technology help students to learn? Can technology-based aids to instruction, such as computer-assisted learning and distance education, help students learn to learn and to become lifelong learners?

The overall field of computers in education can be divided into administrative, instructional, and research uses (see Figure 1). This book focuses on instructional uses. Figure 1 shows three major subdivisions of instructional uses of computers. These are discussed in more detail in the next three sections of this chapter.

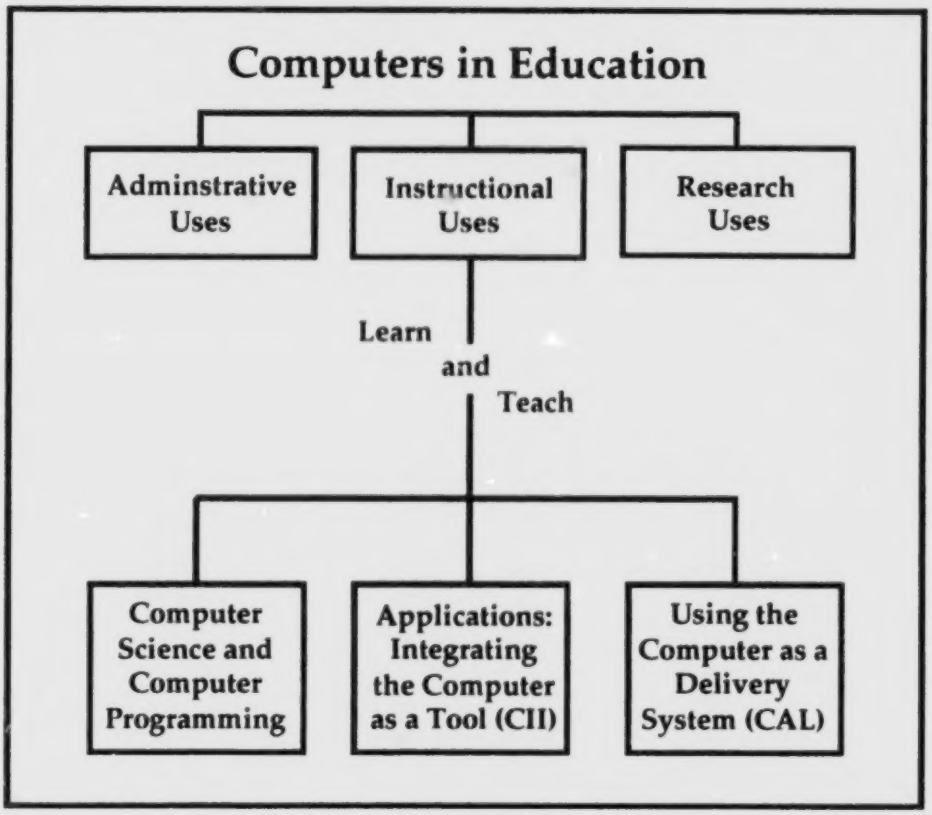

Computers in Education
Adminstrative Uses
Instructional Uses
Research Uses
Learn and Teach
Computer Science and Computer Programming
Applications: Integrating the Computer as a Tool (CII)
Using the Computer as a Delivery System (CAL)

Figure 1. Computers in education.

## Learning and Teaching About Computers

In learning and teaching about computers, the field of computer science, along with related areas, such as information science and data processing, is considered as a subject area. The computer field is clearly an important academic discipline. Many community colleges, colleges, and universities offer degree programs in this discipline. An analysis of current occupations and of job openings suggests that many jobs now require a substantial amount of formal postsecondary education in the computer field. Many of the ideas from computer and information science can be taught at the K-12 level.

Thus, all schools need to make a decision about what to teach from this subject area. Some schools express this decision as a goal that all students should become computer literate, and thus require a computer literacy course. Other schools specify a list of courses offered as electives, such as courses in various programming languages, an advanced placement course, a robotics course, or an electronics course. Still other

schools integrate instruction about computers into a number of curriculum strands.

## Computer-as-Tool and Computer-Integrated Instruction (CII)

In learning and teaching about integrating the computer as a tool, the various academic disciplines consider the computer as an application tool. The emphasis is on learning to use computer application packages and integrating them as everyday tools into a student's overall knowledge and skills. We shall call this process "computer-integrated instruction" (CII). Standard examples of CII software include word processor, graphics, spreadsheet, and database.

In recent years, three different types of uses of computers as tools have developed. There are tools that cut across many disciplines, such as a word processor. We call this a generic tool. There are tools that are quite specific to a particular academic discipline, such as hardware and software to aid in musical composition and performance. We call these subject-specific tools. Finally, there are tools that require some programming skills, but the focus is on learning to learn and on learning nonprogramming areas. We call these learner-centered tools. The hypermedia environments facilitated by *HyperCard* and *LinkWay Live!* are examples of this type of tool, as are the Logo environments.

Progress in developing more and better application packages, as well as better human-machine interfaces, is causing CII to grow rapidly. Also, computer scientists working in the field of artificial intelligence are producing application packages that can solve a variety of difficult problems—problems that are generally considered to require a substantial amount of human knowledge and skill. Such application packages should eventually change the content of a variety of school subjects.

The key questions are: What should students learn to do mentally, what should they learn to do assisted by simple aids such as pencil and paper or books, and what should they learn to do assisted by more sophisticated aids such as calculators, computers, and computerized equipment? These are very hard questions. The slow acceptance of the hand-held calculator into the curriculum suggests that more sophisticated aids to problem solving will encounter substantial resistance. Somewhat surprisingly, many stakeholders are more accepting of computers than they are of calculators.

One can also examine the computer as a tool to increase teacher productivity. The use of a computerized gradebook, a computerized data bank of exam questions, a computerized system to help prepare an individualized educational plan (IEP) for a handicapped student with

disabilities, or even a word processor to write lesson plans and class handouts are all good examples. These increase productivity by improving the teacher's overall efficiency of effort and saving a teacher's valuable time.

## Computer-Assisted Learning (CAL)

Computer-assisted learning (CAL) includes computer-assisted instruction and computer-managed instruction. Historically, most CAL materials have been of the drill-and-practice type. There is now a wide range of CAL materials that go far beyond routine drill-and-practice.

A computer might be used in a supplementary mode, with students making modest use of computers to reinforce instruction provided by other means. Research into computerized drill and practice suggests that this mode of supplementing instruction is quite effective in a variety of subjects and with a wide range of students. However, it is important to note that CAL is not equally effective with all students and that a good education consists of far more than just memorizing the types of materials that can easily be presented in a drill-and-practice CAL system.

In recent years, CAL systems have progressed so that many include sophisticated, interactive tutorials. Sometimes these systems make use of ideas from artificial intelligence to help improve their ability to analyze student responses and to provide appropriate feedback and instruction. In addition, there is an increasing number of highly sophisticated simulations. For example, students can conduct science laboratory experiments designed to allow a wide range of experimentation and to promote learning.

The computer can be used for instructional delivery at every grade level, in every subject area, and with all types of students. Evidence is mounting that CAL is especially useful in special education and in basic skills instruction. In addition, CAL and distance education can provide students with access to courses not available in a teacher-delivered mode in their schools.

This provides a key issue to be addressed by a TAC. Already we are seeing signs that the CAL and distance education packages being sold to schools will become inexpensive enough so that many parents will consider purchasing them for use with their children at home. How can such progress in educational technology be used effectively in the overall educational system available to students? What is an effective balance between such formal education occurring at school and at home? How will equity issues be addressed?

# Technology and Education

Many of today's schools don't look a lot different from schools of 100 years ago, when the idea of public schools with a core curriculum and some electives was already well established.

"Grammar school" students of 100 years ago might have spent fully half of their instructional and study time on spelling and grammar. The range of reading materials was quite limited. Rote memory, drill, and recitation were the keys to education.

However, even 100 years ago, technology was important in education. Teachers made use of chalk boards, and students used pencil and paper. A classroom probably had a globe of the world and a large chart of the alphabet—in lowercase and capital letters. Of course, the chairs and desks were apt to be bolted to the floor in neat rows, with boys and girls carefully separated.

The world has changed a lot during the past 100 years, and the rate of change seems to be increasing. The totality of human knowledge is growing very rapidly. A rote-memory approach to education is ineffective in keeping up with such rapid change.

Computers are just one of many changing technologies in our world. All fields of science and technology are progressing rapidly. What should students be learning about medicine, genetic engineering, space travel, telecommunications, local and global environmental pollution, and other products of technology?

The educational problem presented by rapid changes in the totality of human knowledge (and especially by rapid changes in science and technology) raises two questions:

1. What do we want students to learn? An important variation on this is to ask what we want students to be able to do as a result of being educated. Here the emphasis is on outcomes rather than processes. This is closely related to the increasing emphasis on performance assessment.

2. What roles should technology play in helping students gain the desired knowledge, attitudes, and skills?

These are difficult questions, and a TAC is apt to encounter a diverse set of opinions on appropriate answers. There are many people who feel that a "back-to-basics" movement is both appropriate and necessary. It is important that the TAC address these ideas. The best of modern research on teaching and learning suggests that a back-to-basics movement will not adequately serve the needs of most students and most other stakeholders.

The school reformer responds to the first question by suggesting a curriculum balanced between educational content and educational process. Curriculum content may be specified by a curriculum framework that emphasizes basic concepts and skills to be gained at each grade level. However, such a framework also includes statements about self-esteem, learning to learn, becoming a lifelong learner, gaining higher-order thinking and problem-solving skills, learning to work cooperatively as well as independently, individualization of instruction, and performance assessment.

The school reformer responds to the second question by including statements about computer-assisted learning, students becoming computer literate, and computers-as-tools being integrated into the everyday curriculum. We want students to become productive adults who function well in the full range of environments they will face as adults.

## Some Scenarios

The remainder of this chapter contains some scenarios that depict classrooms of today and tomorrow. The scenarios are intended to be suggestive rather than prescriptive. They are intended to be a representative sample of the types of changes that computer-related technology can help bring to the classroom. Some of these scenarios represent only modest changes from current, conventional classrooms. With appropriate help and encouragement, many teachers can make such changes in their classrooms. A TAC can help such changes occur.

### Language Arts Scenario

Martha is an elementary school reading specialist in a large school. She works with the teachers at each grade level, and she also works with individual students who need special help.

There are two microcomputers and a printer in each classroom. The school also has several clusters of six machines each that are moved from room to room. Martha has been helping a second-grade teacher set up a cluster of microcomputers as six reading/writing stations around the classroom. Each reading/writing station consists of one computer on a table and some printed materials. Some stations are designed for a student to work alone, but most are designed for a small group of students to work together.

Each station is organized to support different types of reading/writing activities. Some of the activities take about a half-hour, and some are designed to require a half-hour a day for several days. Martha and the classroom teacher have worked out a scheduling process

that coordinates the use of the facilities and ensures that every student will work at each of the stations during the next nine weeks.

Martha and the classroom teacher use a general teaching strategy that helps get students started in using the reading/writing stations. After that, as students move to new stations, they seek help from students who have been using those stations.

Each station contains written instructions for the students. It turns out that much of the hardware and software is familiar to the students—they have used it when they were in the first grade and in the computer lab.

**Station 1:** Bobbie is already busy using a piece of software called *Kid Pix*, a graphics program designed specifically for kids. Bobbie explains, "I learned this at home when I was just a kid. Now I'm really good with it!"

Besides the typical electronic paint options, this program contains a "wacky brush," an "electric mixer" button that magically transforms student-created screens, a talking alphabet (English or Spanish), and dozens of "rubber stamps." Since the computer has a sound card, students can record messages to accompany their drawings. The goal at this station is that students gain skills in using graphics software to conceptualize and illustrate their writings.

**Station 2:** Three curious seven-year-old boys sit in front of the computer that has a scanner connected to it. They puzzle over the instructions and clearly need help. The teacher quickly approaches their station to explain the use of this equipment. After a few minutes of instruction, the boys capture all kinds of pictures from printed material available at their table and store them in the computer. Next they will use the word processor to write short stories illustrated with the scanned pictures. The task for the three students is to work together to write and illustrate a story based on the pictures they scan into the computer.

**Station 3:** At this station, a group of students works with two computer programs designed to build knowledge of vocabulary concepts. The first program, *Word Pairs*, uses definitions and examples to teach students to discriminate between frequently confused pairs of words. Students can then practice using the words in exercises that are provided. The second program, *Analogies*, presents an organized method for understanding analogous word relationships. Analogies are grouped according to an overall classification, making them easier to understand and remember. Students at this station take turns providing answers.

**Station 4:** This station contains a CD-ROM book with sound and text both in Spanish and English. There are several Spanish-speaking students in this second-grade classroom. The groups working at this station are

assigned a Spanish-speaking advisor—a student who will work with the group. The intent is that this advisor will help the other students learn a little bit of Spanish and at the same time grow in self-esteem.

Each CD-ROM book contains a classic tale most students have heard before. The CD-ROM book has a digitized human voice that narrates each story. It also features high-resolution graphics, animation, and a variety of music and sound effects that enhance the book's text and illustrations. When the reader uses the computer mouse to select a word, the computer pronounces and defines it. The student can ask for a definition in English or Spanish.

Similarly, the reader can select objects in the illustrations, and the CD-ROM book will respond with some animation, sounds, or other actions of interest. The user has complete control of the pace and narration of the stories. The book can also be customized for the individual needs of each student; for instance, a slow reader can increase the time delay between phrases; partially sighted students can increase the size of the print.

**Station 5:** Station 5 contains the hardware and software for students to create a hypermedia presentation. Teams of four work together, and they undertake a project requiring several weeks of effort. This is a new task for the students, so Martha is working at this station to help the group get started.

The idea is to pick two different types of birds and then develop a hypermedia presentation comparing and contrasting the birds. Possible content includes pictures of the birds, maps of their habitats, recordings of their songs, lists of the types of foods they eat, and information on changes in the environment that affect the birds. Each team member is to do the needed research and develop one part of the presentation. The team is to work together to combine the results into a presentation that each person in the class can use.

**Station 6:** At this station, the computer is linked to the school and city libraries. The goal is to have students learn to find information from two different library sources.

The students have already used the computerized card catalog in the school library. The classroom system that Martha has set up displays a menu of the two libraries. When the students select the city library, they use it just like they use their own school library.

In this task, the students will learn that the city library contains more information than the school library. However, not all of the information at each library is available on-line. Thus, students learn the advantages and disadvantages of the different types of libraries. It is easy to check out a

book from the school library, and it is more work to go to the city library to get a book. However, the city library contains more on-line information.

The specific task at this station is for a team of three students to select a topic and divide it into three pieces. Then, each student is to do library research on his or her piece, getting some information from each library. Then the students are to work together to write a report on their topic.

## Analysis of the Language Arts Scenario

Unlike the students in the scenario, most children currently do much of their academic work and express their knowledge in a textual mode. Outside of school, students live in a world where multimedia—pictures, sound, graphics, motion—is routine. It seems evident that education can be improved by engaging students in the development and use of multimedia as an aid to communication and learning.

Currently, most of the content that students are exposed to in school comes from a very limited number of textbooks. Typically, schools adopt such textbooks on a six-year cycle. Thus, students often learn from books that are hopelessly out of date. Outside of school, the use of computerized databases has grown very rapidly. It seems evident that students should learn to make routine use of the computerized library.

Most students currently have few choices about the topics they will pursue or the way they will represent the results of their work. The scenario pictures a school environment in which students have more freedom of choice, learn to work both in individual and group settings, and learn to communicate in a multimedia environment. Educational leaders believe that all of these features are quite important in an Information Age educational system.

Many elementary school teachers routinely make use of noncomputerized learning stations. They are comfortable with having students engaged in a wide range of tasks, and they know how to deal with scheduling students into a variety of learning stations. In such cases, adding computer-based learning stations is natural and relatively easy.

The use of computer-based learning stations requires teacher education and a good classroom support system for the teacher. With appropriate initial and continuing support, all elementary school teachers can learn to make effective use of the types of facilities and activities described in the reading and writing scenario.

## Math Scenario

Ms. Jones' Algebra II class spends the period in the computer lab, experimenting with a motion detector.

"Ready, go," Ms. Jones cues Susan. Susan slowly backs away from the group. She holds a large piece of cardboard in front of her. After backing up about five feet, Susan begins to walk forward, returning to where she started. A curved line appears on the computer screen. The same image is projected onto an overhead screen the whole class can see.

"All right," Ms. Jones says. "Let's try it again, only move faster this time. The class watches the overhead screen as Susan repeats her actions at a quicker pace.

"Now, let's compare the graphs," Ms. Jones says. She touches a few keys, and the second graph is superimposed on the first. "What can you tell me about these graphs?" she asks.

"The faster Susan walked, the steeper the graph became," Bill comments.

"Good," Ms. Jones replies. "What does the top part of the graph represent?" Ms. Jones traces the graph as it changes the direction of its curve.

"That's where I started walking forward," Susan answers.

"Now, I want each of you to try it. Break into groups of two or three and try to match the graph I'm putting on the screen." Ms. Jones replaces the superimposed images on the screen with an image she created earlier.

After giving the students 10 minutes to experiment with the motion detector, Ms. Jones again directs their attention to the image projected on the overhead screen. She shows some images she has generated using a motion detector.

"What does this have to do with math?" Ms. Jones asks. A few groans can be hard from the students. "Well," she continues, "does this remind you of anything we've been studying lately?"

"Yeah," Paul replies. "It looks like those what-cha-ma-call-it parabola things."

"Right," Ms. Jones continues. "Now I want you to do two things. First, think of some moving objects that may produce a parabola-like distance graph. Second, try to match the parabola-like graph by using one of the forms of the equation for a parabola." Ms. Jones indicates the general formula $f(x) = ax^2 + bx + c$.

Working in groups of two or three, the students engage in discussions and experiments as they address these questions. Some of the students try to walk in such a manner that a parabola-like distance graph

is produced—but without much success. They write results into their journals.

With 10 minutes remaining in class, Ms. Jones again calls for the students' attention. "Now I want you to think about the types of changes in the graph produced by different types of changes in the equation. Make up some rules that seem to cover what you have observed. With the remaining time in class, write in your journals about what you have learned. We'll discuss it tomorrow."

Some students move to computers in the classroom to write about their experience. Others choose to write by hand in paper notebook journals. Some students refer to notes they have taken on their laptop computers during class, and they use the laptops to do their journal writing.

## Analysis of the Math Scenario

Most of the math that students study in school is deeply rooted in useful applications. However, over the years the math curriculum has gradually become more and more abstract and remote from the applications. The mathematics education leadership in this country is now attempting to reverse this trend. They are giving increased emphasis to the use of math manipulatives, to inquiry-based math, and to applications of math to real-world problems. Computers are a versatile manipulative and aid both to learning math and to applying this knowledge to real world problems.

The scenario shows how computers can be used as a learning tool in a math classroom. While still representative of a typical high school math class, it shows how computers can change the emphasis of learning from teacher centered to student centered. Students are directed through the process of discovering mathematical concepts as opposed to learning the concepts through rote memorization. Students show what they have learned through attacking difficult problems and by applying their knowledge to new situations.

Most math teachers received all of their preparation in a "chalk and talk" math learning environment. They are not comfortable in making use of a computer with a projector system or in using data acquisition facilities such as a motion detector. It is evident that it will take a lot of teacher preparation and teacher support to integrate the routine use of computers into the mathematics curriculum.

## Science Scenario

The chemistry class is hard at work. Students are paired up at the computer terminals. Sara and Jeff are studying the element lithium. "Let's

see what happens when we mix lithium and other elements together," suggests Sara. Using their computer workstation, Sara and Jeff are able to see what happens when the lithium is combined with a variety of other elements. They manage to produce several "explosions" that are accompanied by computer messages indicating that if they had actually carried out this experiment in the computer lab, it would now be destroyed. The computer system suggests that they study some of the materials included on a CD-ROM that is part of the library materials for the course.

Elsewhere in the class, Maria and Washington, who are teamed with Sara and Jeff, are working with sodium. They do many of the same experiments Sara and Jeff performed. They write a description of the properties of sodium. Later in the period, Maria and Washington sit at one computer terminal while Sara and Jeff sit at another located on the other side of the classroom. They communicate their findings to each other and use a groupware piece of software to develop a report. Working together through the computer-mediated communication system, they design additional experiments to be carried out by each pair of students and agree on a time when they will again engage in a computer-mediated discussion of the results.

The next day Jeff selects the elements to be tested along with cesium. "Calcium, carbon, and fluorine," he says. They set to work running the reactions. "Look at this," remarks Sara. "Just as we predicted, cesium reacts almost the same as lithium." In the notebook, Sara and Jeff comment, "We have tested lithium, cesium, and several other elements. Based on our results, we can predict the reactivity of those elements in Group 1A."

## Analysis of the Science Scenario

The use of technology-based labs in chemistry classes aids the educational process in three important ways: the speed of the procedures, safety, and communication with their fellow students who are at a different location. In a traditional lab, students would have time to perform only one or two tests per class. With the technology available, Sara and Jeff were able to run many more trials during the class time. They were able to collaborate with Maria and Washington so that each pair of student researchers was able to build on the work of the other pair.

The issue of safety is an important one in science labs. Technology gives students the ability to perform some reaction tests that would be dangerous if done in a traditional high school lab. Another benefit of the use of technology in the lab is its cost-effectiveness. While computer technology is expensive, you can use it over and over again. Many of the materials in labs are consumable—they can be used only once. In that

respect, current labs are also expensive. The budget to run a current science department for five years could be used to purchase the hardware and software needed for an advanced technology lab. These interactive labs give the student the ability to be creative, to explore, and to make the learning connections in a safe environment. In many ways this represents more learning opportunities for every dollar spent.

Leaders in science education indicate that our current passive, textbook-based science curriculum is inappropriate to the needs of the Information Age student. In recent years these leaders have indicated that science needs to be taught in an inquiry-based, hands-on environment. It is evident that computers are a powerful aid to this type of science education. Implementation of such changes in the science curriculum requires a great deal of teacher education and teacher support. The scenario represents a revolutionary change in science education.

## Music Scenario

Mr. Frey's music class has been studying the theory of musical composition. His class has access to a MIDI computer system and a variety of digitized music in a format that allows students to edit each individual instrument. Thus, for example, a student can change the oboe section of an orchestral performance or change the rhythm of a rock performance. Using the same facilities, students can create and edit their own music.

The specific assignment consists of two parts. First, students are to select an orchestral performance and experiment with substantially increasing or decreasing the number of a specific type of instrument in the orchestra. For example, what happens if there is only one violin in the violin section?

Second, students are to select a particular piece of "old" music (something composed at least 20 years ago) and "modernize" it. This project is to include a discussion of what makes a piece of music more modern.

## Analysis of the Music Scenario

Computers are now a routine aid to professionals in musical performance and composition. The cost of such facilities has declined to a level where it is reasonable to make these facilities available to students.

It is evident that use of the MIDI computer facilities adds a new dimension to music instruction. Every student can compose music, edit the composition, and use the computer facilities to perform it. Every student can be involved in an inquiry-oriented, hands-on approach to learning music.

## Art Scenario

Mr. Beck's art class is doing a unit on art history. The class has been divided into teams of three to four students. Each team works on the same assignment:

> You are the curator of a small art gallery, and you get to pick your favorite works of art from one of the videodisc collections available to the class to display in your gallery. (The school library has several such videodiscs; each contains many thousands of full-color reproductions of original art works.) Using the laserdisc station, set up a gallery exhibit and a "tour" of your exhibit. The tour you create should include the following—the images to be displayed, information about the pieces of art and the artists, and a discussion of why you picked the artists and each particular piece of art.

Each group of students creates a computer-based simulation of an art gallery exhibit. The pictures are displayed using a videodisc player controlled by a computer. The commentary and analysis is done on the computer system. Each group of students views the exhibits of the other groups and does a critical analysis of each exhibit.

Mr. Beck also teaches a class on photography. This class makes use of still video cameras that take a picture and store it on a small floppy disk. These images are easily transferred into a computer so that they can be edited.

The specific assignment is to take pictures of people and then to use the computer facilities to age the people—that is, to suggest what they might look like as they grow older.

Many of the students do self-portraits. Bob grows a beard but loses most of his hair and adds a few pounds. He calls his self-portrait "In Thirty Years." Amy adds dreadlocks and puts a pattern on her t-shirt. John uses a morphing software program to change his face into that of a famous movie star.

Several of the students include pictures of Mr. Beck in their exhibits. One has changed Mr. Beck into an angle, while another has changed him into a muscular weight lifter.

## Analysis of the Art Scenario

Computers have been a routine tool in commercial art and in movie-making for many years. The cost of such facilities has now declined to the

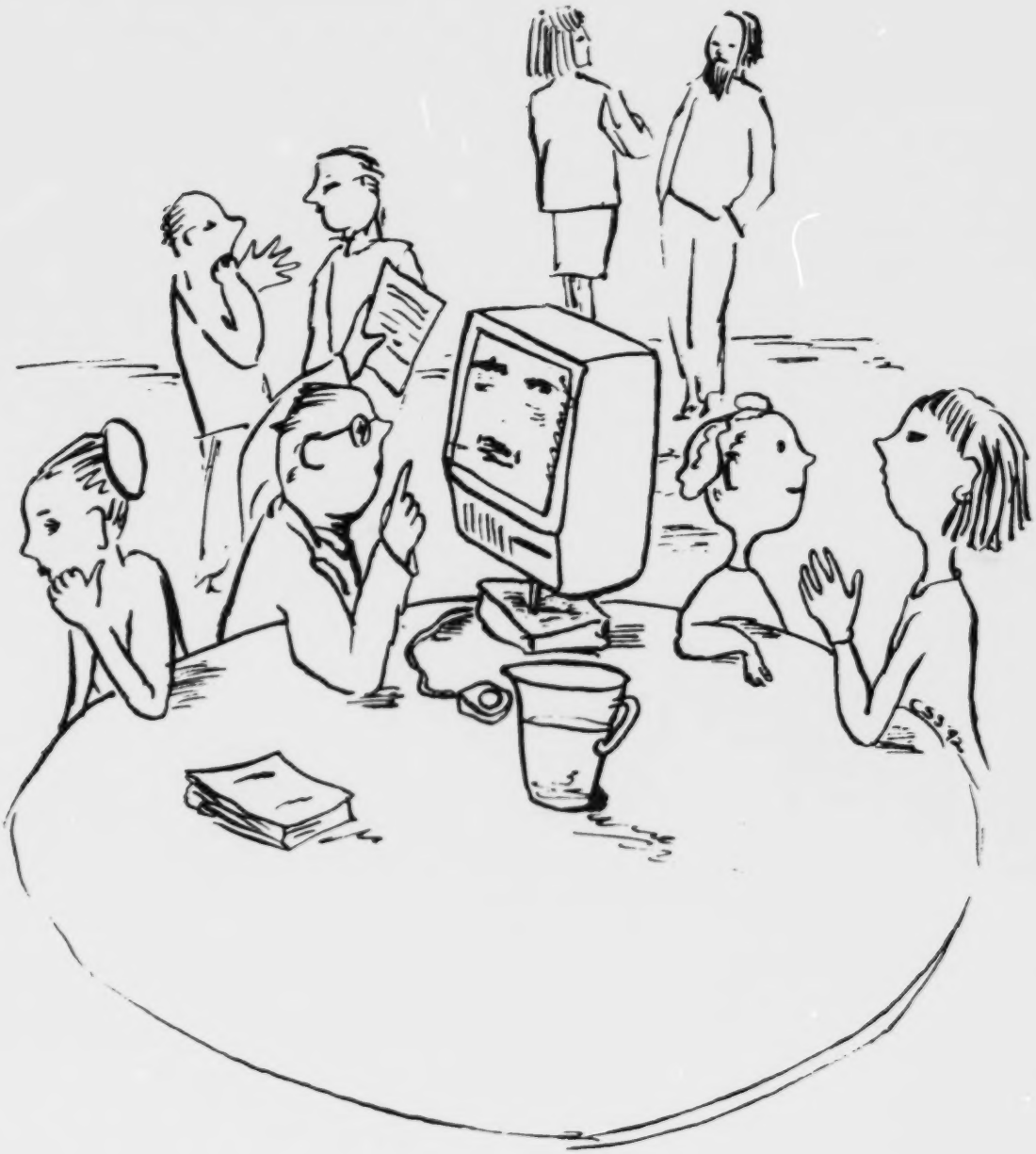
level that many schools now make them available to students. Such facilities add an exciting new dimension to the art world.

In both of Mr. Beck's classes, students are actively engaged in creative processes. They are learning to use the tools of the trade—and they are having fun.

## Closing Remarks

This chapter presents an overview of computers in education and a number of scenarios showing a variety of uses of technology in education. There are two underlying themes in the use of this technology—empowering students and empowering teachers. By far the strongest thrust is toward having students being engaged in inquiry-based, hands-on activities. They are actively engaged. They learn by doing, by working in cooperative groups, and by working on interesting, relevant, real-world projects.

Each of the scenarios requires computer hardware and software. More important, each requires a substantial amount of teacher education, changes in the curriculum, and changes in methods of assessment. Without a major and continuing commitment by the full range of educational stakeholders, such scenarios will not become real and widespread.



# Chapter 3
# Building a Technology Advisory Council

*The pope and a peasant know more between them than the pope alone.*

*Proverb*

A TAC is a group of people with diverse backgrounds and interests who learn to work together. Their goal is to improve the education that students receive in the school or school district. While the overall focus of a TAC is on the entire educational system, the specific focus is on appropriate roles of computer-related technology in content and pedagogy.

There are no hard and fast rules for the size of a TAC, who should be represented, frequency of meeting, or types of activities. The success of a TAC is measured through a combination of how the TAC contributes to improving education and the satisfaction of the individual TAC members.

The TAC's full name, Technology Advisory Council, indicates that the council serves in an *advisory* fashion. It provides well-considered advice to a range of people who are open to receiving advice and in a position to make use of the advice. Thus, a TAC might provide advice to the school board, to school administrators, to curriculum coordinators, to people designing inservice education programs, and so on.

## Who Needs a TAC?

Probably every school and school district can benefit from having a well functioning TAC. Consider the list of questions given in Chapter 1.

1. At what grade levels is it best to have students begin to learn to use computers?
2. Do all teachers, or just "computer" teachers, need to know how to use calculators and computers?
3. How should computer technology affect the content of noncomputer courses, such as reading courses, social studies courses, health courses, and so on?

4. How can we measure if students are learning the "right things" about computers and their uses?

5. Computers cost a lot of money. What is a cost-effective approach to helping students learn about computers?

6. Do we really need to make a lot of changes in our schools in order for our students to learn how to use computers? What role might computers play in the redesign and restructuring of curriculum content and pedagogy so that school is better?

7. Technology is changing very fast. How can our schools keep up (or should we even try)?

8. If our students learn to use computers, will it help them get better jobs? What should our schools emphasize about computers if the goal is to help students get better jobs?

Answers to these and similar questions are highly dependent on the individual school or school district. In many cases, answers represent the values of the stakeholders and the specific goals of a school or school district. Answers will vary depending on whether the school is an inner-city ghetto school, a small rural school, or an affluent suburban school.

Who should provide answers to the questions? Should it be the school board? The superintendent? Principals in the individual schools? A computer coordinator? Individual teachers? It is obvious that there are varying points of view.

It is highly unlikely that one individual or one category of stakeholders can produce answers that are satisfactory to the full range of stakeholders. Even if this were possible, having "the answers" does not suffice. The key to school improvement is successful implementation of well-thought-out ideas. This cannot occur unless a wide range of stakeholders work together on implementation. This rarely happens unless the same stakeholders are deeply involved in developing the proposed changes.

## Getting Started

One stakeholder, such as a student, a parent, a teacher, or a school board member, can be the catalyst that initiates action leading to the formation of a TAC. Typically, three steps occur:

1. One stakeholder, or perhaps a very small group of stakeholders, decides that the school or school district needs a TAC.

2. The initial person or small group "talks it up" with friends and acquaintances, building an initial level of grass-roots support.

3. The grass-roots group tests the political waters by informal discussions of their ideas with a wider range of stakeholders, particularly with school administrators, school board members, and key business people.

If these steps are successful and it appears that there may be a very wide range of grass-roots support, it is time to put out some publicity and hold an organizational meeting. If severe opposition seems to be coming from key stakeholders, such as the superintendent (for a district TAC) or the principal (for a school TAC), this difficulty needs to be resolved before going ahead with an organizational meeting.

## An Invitational Letter

The organizational meeting should be open to the public—the goal should be to have a very large number of attendees. The organizational meeting is designed to acquaint a large number of people with the general nature of the problems the TAC will address and to seek volunteers who might be interested in serving on the TAC. It is desirable that the organizational meeting receive advanced publicity through the media and that media people be at the meeting.

Here is a sample letter that might be widely distributed to invite people to an organizational meeting. Also, please note the eight letters in Appendix 1. Purchasers of this book are given permission to adapt these letters and the following letter for noncommercial purposes. Each of the letters in Appendix 1 can be modified to include an invitation to participate in the organizational meeting.

> Dear -----:
>
> This letter is being sent to a large number of people who are interested in our schools and the quality of education our children are receiving.
>
> You are aware of how technology is changing our world. You know that computers are used routinely in many different jobs. You know that students need to learn about such technology if they are to be successful, productive adult citizens.
>
> The people who have signed this letter feel that we need to develop a Technology Advisory Council that will work to improve the education our students receive. It is important that this council be representative of students, parents,

teachers and school administrators, business people, and others who are interested in our school system.

This letter is an invitation to attend an informational meeting to be held on (give time and place). At that meeting you will see some student presentations on the ways students currently use computer technology. You will see some short videos that show some of the potential for school improvement based on increased, appropriate use of this technology.

Finally, you will be given the opportunity to volunteer to participate in the formation of a Technology Advisory Council. This council will meet approximately once a month. Its members will learn a great deal about school improvement and change and the appropriate roles of technology in school improvement. The Technology Advisory Council will make a major contribution to improving the education our children receive.

Refreshments will be served.

Sincerely yours,

(The letter should be signed with the names and titles of at least a half dozen people who are supporting this activity. The titles should indicate the differing stakeholder groups, such as student, parent, business person, and others.)

## The Organizational Meeting

The organizational meeting needs to be carefully orchestrated. Perhaps the most important consideration is that the meeting display an initial unity of purpose. If a half dozen key stakeholders who are perceived as important representatives of their groups each gives a brief statement of support, this can make a world of difference.

Appendix 4 lists a number of books that might be on display and loaned to potential TAC members, and Appendix 5 lists a number of videos that might be appropriate to show at the meeting.

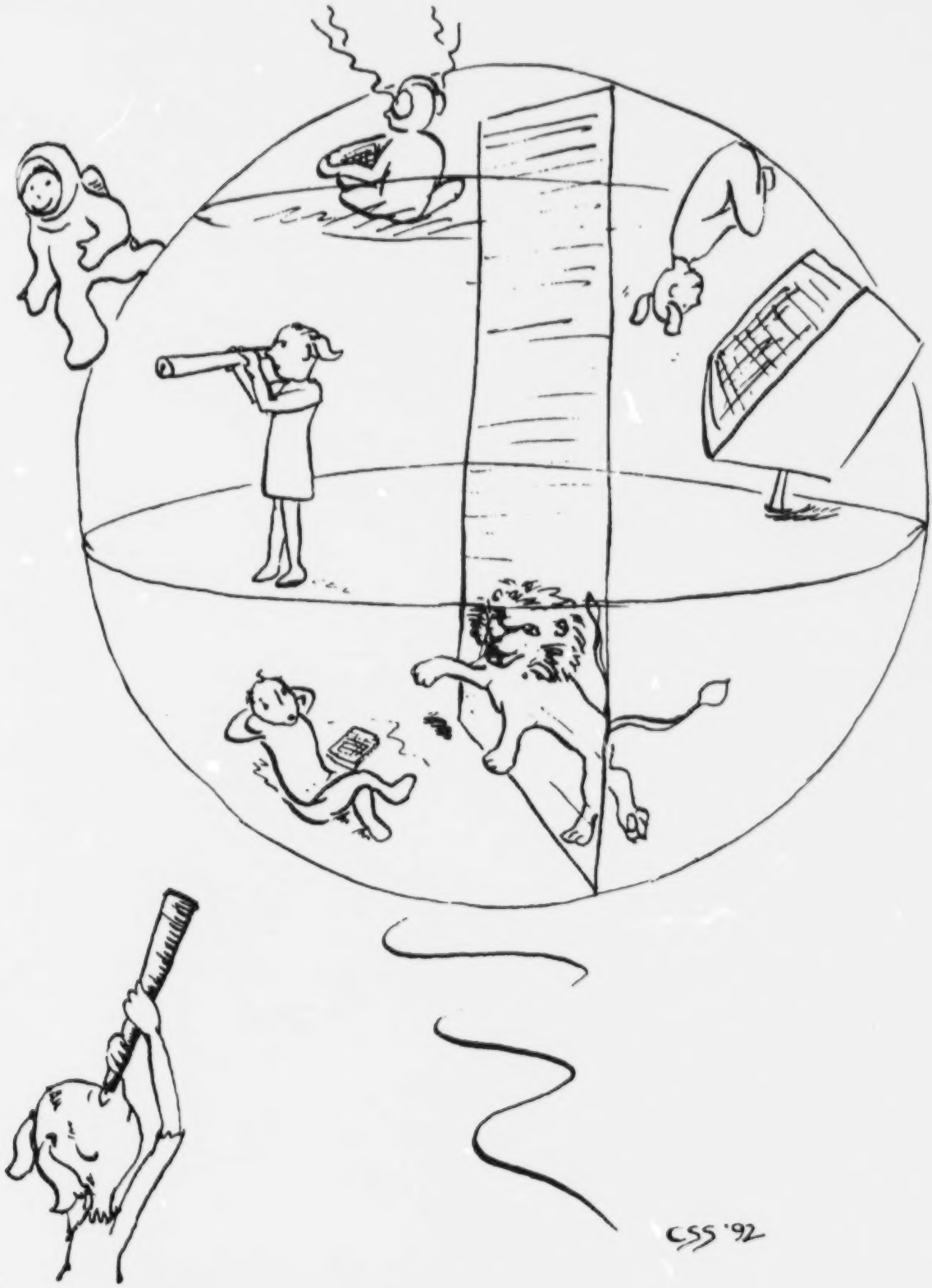
Education is a human endeavor. The TAC is a group of people who learn to work together toward a common goal. Thus, the initial organizational meeting should have its focus on people. The meeting should be run by a person who is highly skilled at facilitating group participation and in the development of consensus. The meeting should include some small-group activities in which people get to know each other and all attendees get a chance to put forth their ideas.

Near the end of the organizational meeting there should be a request for volunteers who may be interested in becoming TAC members. This request should be worded carefully—you probably do not want to guarantee that every volunteer will be on the council. Also, you want to allow for the possibility that some people who were not at the organizational meeting will end up serving on the council.

## Closing Remarks

Currently, technology is one of the most powerful agents for change in our educational system. Thus, a TAC can play a key role in school improvement.

The TAC must be broadly representative of the stakeholders and must not be dominated by a single individual or stakeholder group. The TAC will grow in stature and evolve in purpose over time. TAC members must feel that the time and effort they put into the council is well rewarded, both in terms of their own personal growth and learning, and in the school improvements that result.

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# Chapter 4
# The Strategic Planning Process

*"If you don't know where you are going, any path will take you there."*

*Lewis Caroll*

*Nothing is more dangerous than an idea, when you have only one idea.*

*Emile-Auguste Chartier*

Computers are here to stay, and computers will have a steadily increasing impact on our society. Because of this, every school needs a plan to deal with this changing technology.

This chapter discusses "strategic" long-range planning. A long-range plan looks five to six years or more into the future. It includes a strategy for implementing the plan. It provides a basis for the major, long-term strategic decisions a school or school district must make as it works to implement appropriate use of computer technology throughout the curriculum.

Long-range planning takes careful thought and quite a bit of work. It is absolutely essential that the plan be developed by the people who are affected by the plan—the stakeholders.

Stated briefly, the TAC needs to:

1. Decide on a mission statement for the TAC.
2. Develop a number of long-range goals for computers in the curriculum.
3. Develop an implementation plan.
4. Set up a mechanism for yearly review of the implementation efforts and the plan. This mechanism must include provisions for revising the plan whenever it becomes evident that such revision is needed.

The TAC needs to be aware of the resources available for implementation. That is, the planning for what needs to be done and the

planning for how to do it tend to go hand in hand. This is one of the reasons that the people who are to implement the plan must be represented on the TAC.

Previous chapters in this book have contained scenarios in which classrooms made appropriate uses of technology. One way to begin a strategic long-range planning process is to have members of the TAC write scenarios of what they would like schools to look like. Such scenarios are an excellent vehicle for sharing diverse points of view. As the TAC members share their scenarios, they come to know each other better, and they begin to appreciate the value of the diversity of opinion the TAC members represent.

The remainder of this chapter offers some guidelines for strategic planning.

## The Starting Point—A Mission Statement

The starting point for strategic planning is a mission statement. The mission can be thought of as an overall goal. At one time the mission of the March of Dimes was to conquer polio. Now the mission is to conquer birth defects. An organization wants to have a mission that is understandable and easy to state. It should be possible to tell when progress is occurring toward accomplishing the mission. For many organizations, the mission may take a long time or forever to accomplish.

The TAC's mission statement needs to be consistent with and supportive of the goals of the schools. Remember, the TAC is usually an *advisory* group for a school or school district. The resources and authority to implement the advice lie mainly within the school or school district. Here is a sample mission statement:

> The mission of the TAC is to ensure that all students at (name of school) are "technology literate" in a manner that will support their future as a lifelong learner and as a productive, well-informed citizen.

## Process and Product

Strategic planning is a process that leads to a product. The product, a strategic plan, is useful to the extent that it represents good and careful thinking, that it is implemented in an appropriate and thoughtful manner, and that it contributes significantly to accomplishing the mission of the organization. Many organizations find that the process of developing a strategic plan contributes as much or more to an organization than does actually having such a plan in hand. However, a strategic plan is very important to have available because it provides a framework for day-to-

day and longer-term decision making on the part of the staff and volunteers who work for the organization.

The type of strategic plan discussed here is a long-range plan that covers a period of five to six years. A period of five to six years is long enough to implement a significant change in a system or an organization. The research literature on strategic planning indicates that five to six years is a "natural" period of time for all kinds of organizations to develop and implement long-range plans.

Generally, completion of a long-range strategic plan then leads to the development of a medium-range plan that covers two to three years, and a short-range plan covering one year. One-year plans are particularly important because typically one can accurately forecast the resources (money and people) that will be available during the year.

Once a long-range strategic plan is in place, it needs to be updated each year. This provides a basis for annually updating the medium-range plan and the next year's plan. All of this gets tied into the budget cycle, because a year's budget is designed to accomplish the specific short-term goals in the coming year.

## Four Key Steps

Here is a brief outline of a commonly used strategic planning process. This outline assumes that the organization has a well-defined mission statement that can be used as a starting point for strategic planning.

1. Analyze the environment and the planning assumptions. Identify the key stakeholders and the current state of affairs. Gather and analyze data on what is working well and what is not working well.

   For example, what is the current use of computer technology in the school and what are students learning about such technology? (Chapter 5 of this book discusses the methodology for answering these types of questions.)

2. Develop a list of possible goals and objectives. This can be done by starting at the visionary goals level and then moving toward more specific long-range goals and supporting objectives. Begin to analyze the absolute and relative merits of the proposed long-range goals and objectives.

   Visionary planners look many years into the future. For example, a child is about to enter kindergarten. What will the world be like when this child graduates from high school or community college? What knowledge about computer technology and what skills in its

use will this kindergartner need on the job or as a homemaker 15 years from now?

3. Develop and implement a screening, prioritizing, and selection process that leads to the selection of an appropriate and manageable set of specific goals and objectives. The research literature indicates that a good strategic plan should have a limited number of goals and objectives. A half dozen major goals, with two or three objectives backing up each one, is desirable.

Chapter 6 discusses some possible goals for computers in education. The ideas in that chapter can serve as a starting point for discussion. However, it is unlikely that a TAC will merely accept this list of goals and consider its work completed.

4. Develop an overall implementation plan based on the accepted goals and objectives. The implementation plan has short-term (perhaps one year or less), medium-term (two to three years), and long-term (five to six years or more) components.

   Most likely a TAC will develop only a rough plan for implementation. Details are best left up to the school personnel who have the authority and responsibility for implementation. Some advisory councils have a tendency to "micro manage"—to attempt to spell out small details of what is to be done to achieve particular goals. This is inappropriate and can seriously hinder a school from actually achieving the goals.

## Implementation and Evaluation

Once a plan has been developed, school personnel will choose, organize, and work on specific activities that are based on the overall implementation plan and that lead to achieving the adopted goals and objectives. They will also set in place an evaluation process that provides information needed by school personnel and the TAC.

By and large, it is school personnel who will implement the plan. However, the plan may call for the development of school-business partnerships. It may call for community-wide fund raising. It may call for a new tax initiative. Thus, members of the TAC may be involved in implementation.

Evaluation must be an ongoing part of implementation. A key idea is that results from the evaluation are fed into current planning. The TAC must periodically revise and update the strategic plan based on the ongoing formative evaluation process. The long-range strategic plan should be carefully examined each year and should be updated based on information gathered during the year. Typically, the updating process

takes only a small fraction of the time and effort used in the creation of the original plan.

## The Planning Process May Be Unsuccessful

A group approaches the strategic planning process assuming that it will be successful. However, a strategic planning process can be unsuccessful. Here are four reasons for this; failure can be avoided by taking appropriate care in the planning process.

1. The planning process is carried out in a poor fashion. Inadequate time, energy, and other resources are devoted to the task. The resulting plan is not visionary enough, contains major flaws, and is not worth implementing.

2. The planning process does not adequately involve the key stakeholders—the people who are affected by the plan and who will be involved in implementing it. Consequently, they do not support the plan and they sabotage its implementation. They may do this in a quite passive manner, and not deliberately, merely by not throwing their energies and "clout" into getting the goals accomplished.

3. The plan is not periodically updated based on formative evaluation data gathered during implementation. The plan quickly becomes outdated and is ignored by the implementors. A five-year strategic plan needs to be updated yearly.

4. A major and unforeseen change occurs that literally destroys the plan. What happens if the school's technology coordinator leaves to go to graduate school, or the superintendent who strongly supports the plan decides to retire? Note that it is possible to do contingency planning for various types of changes. A final plan can be examined in light of a variety of scenarios that the original planners might not have considered. A well-designed, robust plan will stand up well under such scrutiny.

## Closing Remarks

The process of building a strategic plan is a process of educating the stakeholders. As they grow in knowledge and in mutual trust, they will gradually come to understand the field of computers in education and the most important goals for their school. They likely will develop consensus or near-consensus on what will be best for the school or school district.

The two most important ideas in strategic planning are to fully involve the stakeholders and to review the plan annually and update it as needed.

# Chapter 5
# Gathering Baseline Data

*Those who cannot remember the past are condemned to repeat it.*

*George Santayana*

Both for long-range planning and for measuring change, it is desirable to have a "snapshot" of current and past roles of computer technology in your schools. This chapter outlines a process for gathering a modest amount of baseline information. Some TACs will want to gather considerably more information to help them do their work.

## Initial Planning

It takes money, time, and effort to gather and analyze data. Thus, before you start gathering data, think about how you will use it. Two obvious uses are:

1. To provide historical and baseline data for measuring long-term change.

2. To provide information for decision making.

In each case, it is possible to gather a great amount of quite detailed data. However, you should keep asking yourself how the information will be used. For example, it might be possible to determine the brand, age, location, and past and current level of use of every piece of computer hardware and software available to students and teachers at school, at home, and in the community. It might even be possible to maintain and update this list year after year. Suppose that you had this information. How would you use it? Is the use worth the cost of gathering it?

Perhaps information about computer access at the community library and in students' homes is interesting but will not enter into any of the decisions the TAC needs to make. Perhaps all that is really needed is a current inventory of the hardware and software in the school. The key issue is the cost-effectiveness of the information. Will the value of the information exceed the cost of obtaining it?

## Narrative Description

It is helpful to prepare a short narrative description of instructional use of computer technology in the schools and in the school district. What is the historical background? Who are the key people who have been involved and/or who are currently involved? What are past and current major success stories? Have there been major failures? Does a long-range strategic plan exist? If yes, is it useful?

The narrative description can also summarize the key findings that come from gathering the data described in the remainder of this chapter.

## Essential Information

Each TAC needs to decide what constitutes essential information. Probably the following four categories need to appear on the list:

1. An inventory of hardware and software, including its current state of repair and how much it is being used.
2. Teacher knowledge about computers, access to computers, and level of use of computers.
3. Student knowledge about computers, access to computers, and level of use of computers.
4. The nature and extent of the support system for technology-related facilities and activities. Is there a computer-oriented infrastructure in place that can adequately support the needs of students and educators?

### Inventory of Hardware and Software

Many schools have a great deal of underutilized or unusable hardware and software. There may be computers sitting in closets, software that has never been opened, and technical manuals that have never been unpacked. Some hardware and software may be in disrepair. For each piece of hardware and software you will want to have:

1. A description (include brand and model, date acquired, and cost).
2. The location (identify who has access to it and how easy it is to access).
3. Its state of repair—does it work reliably, only sometimes, or is it broken? For hardware, is it under warranty or a maintenance contract? For software, is it a legal copy; is there a classroom, school, or network license; was a warranty card sent in so that software upgrades may be obtained inexpensively?

4. Its level of use (never, seldom, frequently, to full capacity).

A more detailed inventory would include books, technical manuals, subscriptions to periodicals, spare parts (such as computer cables), and so on. If such detail is not needed, one might merely evaluate each major category of resources on a four-point scale, with increments labeled None, Minimal, Adequate, and Excessive.

## Educator Knowledge, Access, and Use

In this section, we use the term "educator" to include teachers, instructional assistants, school counselors, library-media personnel, administrators, and other school staff. Most likely a TAC will only need approximate data on educator knowledge about computers, access to computers, and use. A self-reporting method can be used to gather the data. Each educator can be asked to respond to a simple questionnaire that includes such questions as the following:

1. How would you rate your knowledge of computers?

   A. Essentially none. I don't have enough computer knowledge to use a computer in my job.

   B. Minimal. I know enough about computers to make some simple uses of them in my job.

   C. Adequate. I feel that I have adequate knowledge and skills to make effective use of computers. I am comfortable using computers in my job.

   D. Superior. I am comfortable in helping other educators develop the knowledge and skills they need to adequately use computers in their professional work.

2. How would your rate the ease of access to computer facilities to support your professional work?

   A. Totally inadequate; essentially nonexistent.

   B. Minimal. I can get access when I really need it, but it requires considerable effort.

   C. Adequate. I have adequate access to fit my needs.

   D. Superior. I have very good access wherever I want to work (including at home if I do some of my work at home).

3. How would you rate your level of use of computers in your professional work.

A. Essentially none. I seldom or never use computers to support my professional work.

B. Minimal. I use computers occasionally.

C. Adequate. I routinely use computers to support my professional work.

D. Superior. I typically use computer facilities several times a day and in many different ways to support my professional work.

## Student Knowledge, Access, and Use

Most likely a TAC will develop goals for student use of computer facilities. These might be rather general, such as a goal that all students will know how to use the library's computerized card catalog by the time they finish middle school. Or the goals may be far more specific, such as a goal that all students in the Office Practices class must demonstrate a high level of competency in using telecommunications, spreadsheet, database, word processor, and graphics software on two different brands of computers in order to pass the course.

Some student data are needed as one begins to develop goals for instructional use of computers. Perhaps additional data are needed as specific goals are developed, in order to know the current levels of student knowledge and skills relative to the goals.

In some cases, student data can be obtained from school records and/or from specific teachers. A different approach to obtaining the minimal amount of needed information is to have TAC members and a few selected teachers respond to the following questions:

1. How would you rate our students' knowledge of computers?

   A. Essentially none. Most students do not know enough about using computers to be able to use them in their school work.

   B. Minimal. Typically, at each grade level, student knowledge about computers is far less than I think would be appropriate.

   C. Adequate. Typically, at each grade level, student knowledge about computers is about what I think would be appropriate.

   D. Superior. Typically, at each grade level, student knowledge about computers is far better than I would expect.

2. How would you rate our students' ease of access to computer facilities to support their school work?

A. Totally inadequate; essentially nonexistent.

B. Minimal. While there are some computers for student use, it is quite inconvenient for most students to get access to the facilities.

C. Adequate. Most students can easily get access to computers when they want to.

D. Superior. All students have easy access to computers at school and at home.

3. How would you rate the actual level of student use of computers?

A. Essentially none. Most students never use computers.

B. Minimal. Some students use computers, but not very frequently.

C. Adequate. All students use computers for school work, typically more than once a day.

D. Superior. Students routinely use computers throughout the school day and in doing homework where appropriate.

This part of the data collection can also include gathering a list of computer-related courses and curriculum available to students. Are there any required courses? Where do students obtain their initial instruction on keyboarding? Are calculators routinely available to students? Are graphing calculators routinely used in secondary school science and math classes?

Another area of particular concern is articulation. If students learn specific uses of computers at one grade level, is this use supported and encouraged at the next grade level and in other classes being taken at the same grade level?

## The Support System

This section contains a short list of questions that TAC members and/or appropriate school personnel can answer. They are questions about the computer "infrastructure"—the support system. When a school system has only limited computer facilities and only a few educators use the facilities, little infrastructure is needed. However, as the facilities grow in size and use spreads, a considerable infrastructure is needed.

1. Are there computer coordinators or technology coordinators in each school and for the school district? How much of their paid time is allocated to these positions? Do they have job descriptions that specify their computer-support duties and how they are evaluated?

2. If the school or district has a computer network, who is in charge of it? Who provides the needed technical support, routine backup of files, periodic removal of unneeded files, and so forth?

3. Is there a preventative maintenance and repair system in place? When a student or educator feels that hardware or software is not working correctly, what is the procedure for obtaining help to remedy the situation?

4. Do all educators have easy access to ongoing staff development for learning to make appropriate use of technology?

5. Are there completely separate staffs and facilities for instructional and administrative use of computers, or is there substantial overlap of staffs and sharing of facilities? Why?

## Closing Remarks

The TAC needs some data to support its planning and decision making. There appear to be two natural tendencies. One is to gather far too little data (flying by the seat of your pants), and the other is to gather far too much data.

A TAC can achieve a balance between these extremes by first aiming only at gathering essential data. Then, as the need becomes clear, gather additional data that is appropriate for supporting the decisions that must be made. Keep in mind that valuable resources (especially the time of educators) are used up in gathering and processing data.

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# Chapter 6
# Megatrends: Computers in Education

*The empires of the future are the empires of the mind.*

*Winston Churchill*

*The slowest of us cannot but admit that the world moves.*

*Wendell Philips*

Strategic planning requires having good insights into the future. This chapter analyzes major technology-based changes going on in our schools. It attempts to predict the future. Chapter 7 discusses current and future technology. Taken together, Chapter 6 and Chapter 7 provide some of the background TACs need in order to do strategic planning.

## The Information Age

According to Naisbitt (1982), the Information Age officially began in 1956 in the United States. In that year the number of white collar workers first exceeded the number of blue collar workers. Roughly speaking, white collar workers work with information and/or provide services as opposed to working in manufacturing jobs. Teachers, bank tellers, fast-food servers, and grocery store clerks are all considered to be white collar workers.

Viewing these changes from a historical perspective, the percentage of farm workers in the United States has declined from about 90 percent of the work force in 1776 (when the Revolutionary War began) to about 50 percent in 1876 to less than 3 percent now. The percentage of blue collar workers in the United States peaked at about 55 percent of the work force after World War II, and is now well under 20 percent of the work force. The trend toward more white collar jobs and fewer blue collar jobs is still continuing.

Naisbitt describes a megatrend as an important trend that is already established and that is likely to have a significant and continuing impact during the coming decade or longer. Naisbitt identifies megatrends through content analysis of periodical publications such as newspapers.

He is assisted by a staff that culls through and classifies many thousands of articles each year.

## Megatrends: Computers in Education

The authors of this book have identified the following 10 megatrends in the field of computers in education. While these megatrends focus on education within the United States and Canada, similar megatrends will likely occur in educational systems in other parts of the world.

1. There will be continued rapid progress in improving student and teacher access to technology to support learning and teaching. Key areas of progress we can expect during the next decade include:

   A. Much better human-machine interfaces, including voice input and pen-based systems. It will be easier to interact with computers. ("Virtual reality" is an example of a much-improved human-machine interface system.)

   B. Much greater availability of computer-related facilities, including easily portable equipment. Many students and teachers will have portable computers the size of a textbook or even a pocketbook.

   C. Much greater computer access in people's homes. A computerized home entertainment and information retrieval center will become common. In many homes, this will be connected via the telephone system or cable TV system to other entertainment and information sources. Increasingly, the connection will be via fiber optic, thus supporting interactive video.

2. In the area of telecommunications, electronic networking, and access to information, we will see major increases in:

   A. Telecommunication (electronic mail, access to online databases, Fax). Computers will be networked at the school, school district, and state levels. Increasingly, students and educators will routinely telecommunicate across state and national boundaries.

   B. Computerized libraries. The concept of library-as-building or library-as-place will gradually disappear as more and more information is stored electronically and accessed from remote locations. The storage capacity of hard drives, CD-ROMs, and other bulk storage devices will continue to grow rapidly. Thus, the contents of personal libraries will grow very rapidly.

C. Administrative support in the form of information resource management systems. Administrative and instructional systems will interact with each other. The school and school district Information Resource Manager (IRM) will play an increasingly important role in working with both instructional and administrative computer systems. The dividing line between such systems will blur.

3. In the areas of computer-integrated instruction and using the computer as a tool, integrating software into the curriculum will occur in three broad categories: generic productivity tools, subject-specific tools, and learner-centered tools. All three types of software use will grow rapidly during the coming decade.

   A. Generic tools. These are general purpose tools that can be used in many different disciplines. At the elementary and middle school levels, students will learn to use word processor, database, computer graphics, and other interdisciplinary tools. At all grade levels there will be an increased use of hypermedia, from desktop publishing and desktop presentation to sound, graphics, and animation in everyday student projects. This will be accompanied by a proliferation of various templates upon which students can build so that they will not have to start from scratch with each project.

   B. Subject-specific tools. The professionals in each discipline have developed tools that enhance their productivity. The effective use of these tools generally requires a great deal of subject-matter knowledge within the discipline where the tools are to be used. For example, software has been developed that can solve a wide range of algebra problems. However, it takes substantial knowledge of algebra in order to make effective use of this software. The subject-specific computer tools will gradually become an integral component of the content of their respective disciplines.

      The general idea here is closely related to research on problem solving, which indicates that it takes a great deal of domain-specific knowledge in order to be good at solving problems within a particular domain. A computer program can be written that can help an organic chemist to solve problems in organic chemistry. However, the program is of little use to a person who has no formal knowledge of chemistry and specific knowledge of organic chemistry. Additional discussion of domain specificity in problem solving, and its educational implications, can be found in Gardner (1991), listed in the Educational Reform section in Appendix 4.

There is a growing trend toward integrating the use of subject-specific software into the secondary school curriculum. Computer-assisted drawing, desktop publishing, and accounting packages are now in common use in many secondary schools.

C. Learner-centered tools. Learner-centered software allows the student substantial freedom to explore and manipulate a hypermedia learning environment. The teacher, individual students, and groups of students work together in this hypermedia environment, often undertaking projects of considerable size that cut across several disciplines. The Logo environment envisioned by Seymour Papert was an early example of learner-centered software. Hypermedia environments such as *HyperCard* for the Macintosh, *HyperStudio* for the Apple II and Apple IIgs, and *LinkWay Live* for MS-DOS machines provide examples of learner-centered tools.

4. Computer-assisted learning (CAL) will become a routine part of the instructional delivery system. The large commercial packages of CAL are commonly called Integrated Learning Systems, or ILSs. These systems will increasingly include better computer-managed instruction components and computer-adapted testing components. Computer tools that can aid in problem solving and information retrieval will increasingly be built into the ILSs. That is, Megatrends 3 and 4 will gradually merge.

5. Hypermedia will have an increasing impact on content and pedagogy in education. Students and teachers will routinely work in a hypermedia learning environment. They will create and use hypermedia documents. Students will work on interdisciplinary projects, guided by teams of teachers from the various disciplines.

6. Artificial intelligence, and especially expert systems, will have an increasing impact on content and pedagogy in education. An expert system is designed to contain some of the knowledge of a human expert or group of human experts in a particular field, and it attempts to solve problems by using this knowledge. This means that schools will increasingly be faced with this difficult question: If a computer can solve or help solve a particular category of problems, what should students learn about solving this category of problems? Because computer capabilities will continue to improve quite rapidly, curriculums attempting to address this question will be in constant flux.

7. Teacher education programs will increasingly prepare teachers to move into computer-rich learning and teaching environments. Students entering teacher education programs will increasingly have

been computer users for many years before they started college. College of Education faculty will become more computer-competent and will increasingly integrate computer use into their courses. The National Council for the Accreditation of Teacher Education (NCATE) and other teacher-training accreditation organizations will begin to require that all preservice teachers become computer literate. Such groups as the International Society for Technology in Education, which is a societal member of NCATE, have been strong advocates of implementing such standards.

8. Distance education and computer-assisted learning will continue to become more cost-effective and will cover a wider portion of the overall curriculum. This will support a growth in home schooling. Schools will restructure to better implement research-based innovative ideas for improving education and to better take advantage of the potential of computer-based technology, distance education, and computer-assisted learning.

9. Personal Digital Assistants (PDAs) will become commonplace. A PDA is a portable computer-based system designed to fit a range of personal needs. A computerized appointment book provides a simple example. Increasingly, such PDAs will use pen-based input; will handle text, graphics, and sound; will incorporate ideas from artificial intelligence; and will be priced for the general consumer market.

10. There will be growing confusion about the most appropriate and effective roles that classroom teachers should play in the overall instructional delivery system. The teacher will become less and less *the* source of information and *the* information delivery system. Instead, the successful teacher will be a facilitator, a guide, a mentor, a learner, a role model.

## Closing Remarks

It is not easy to predict the future correctly. Some of the megatrends listed here may prove to be incorrect, and other important trends may have been missed. However, each of the predictions is based on an analysis of a current trend that has been going on for quite a while and that shows strong signs of continuing.

If the predictions prove to be correct, the overall result will be a continued rapid growth in computer-related facilities in schools and homes. This suggests a continued rapid growth in need for staff development and for providing support staff. It reinforces the need for schools and school districts to have TACs.

HOW TO
SENDER
Pandora's, Unltd.
THIS END UP
TO
ABC School District

# Chapter 7
# Current and Future Technology

*Mr. Watson, come here, I want you.*

*Alexander Graham Bell*

*to his assistant (March 10, 1876)*

*Any sufficiently advanced technology is indistinguishable from magic.*

*Arthur C. Clarke*

Computer-related technology is both quite simple and quite complex. On the one hand we have the computer. The basic underlying theoretical concepts of an electronic digital computer have changed relatively slowly. On the other hand, we have the consumer products based on computer technology. These have changed very rapidly.

For example, many people trace the roots of the current electronic digital computer to Charles Babbage (1792-1871). Others point to the theoretical and applied work of Alan Turing, who in 1936 wrote a research paper that defined the abstract concept of a digital computer. In some sense, all current electronic digital computers are merely implementations based on the theoretical and applied ideas of pioneers such as Babbage and Turing.

However, the range of computer-related hardware and software applications has become enormous. The potential roles of computers in education tend to be mind-boggling. This chapter contains brief discussions of some of the computer-related facilities that are proving useful in schools. While most of the focus is on hardware, it is important to remember that a computer system includes both hardware and software, and that both curriculum development and staff development are essential components of making effective use of computers in schools.

## Key Characteristics of Computers

There are many underlying ideas in the computer field that change slowly, if at all. A good understanding of these ideas can provide a solid foundation for long-range planning.

A computer is a machine designed for the input, storage, processing, and output of information. The electronic digital computer stores information in a digital form, typically using a binary code of 0s and 1s. Such a machine is designed to rapidly, accurately, and automatically follow a very detailed, step-by-step set of directions (called a computer program) that is stored in the computer's memory. Speed, accuracy, and automaticity are hallmarks of modern computer systems.

Computer software—computer programs—are detailed, step-by-step sets of directions. There are now huge libraries of software that has been designed to solve or help solve a wide range of problems. Thus, automaticity of problem solving is one key characteristic of computers.

A computer program, or a set of directions to be carried out by a computer system, is often called a *procedure*. The overall thinking required in developing and using procedures is often called *procedural thinking*. Thus, procedural thinking is an underlying concept in the computer field that changes relatively slowly over time. However, details of the hardware and software that support procedural thinking change very rapidly over time.

The basic components of computer hardware are the central processing unit (CPU) and the primary memory. The primary memory holds the program and data being processed by the CPU(s) while the processing occurs. Thus, speed of the CPU(s) and storage capacity of the primary memory are key hardware characteristics of a computer system. Both the speed and the storage capacity have increased very rapidly over time and will continue to do so for many years to come.

Other computer hardware includes a wide range of equipment to prepare information that can be processed by a computer (including a video camera and scanners), storage devices and media (including a CD-ROM and CD-ROM reader), and output or display devices (including projectors and printers). All of these can be networked to facilitate communication among the people and machines that work together to accomplish a particular task.

## Microcomputers, Laptops, and PDAs

For most teachers, the term *computer* is synonymous with *microcomputers*, which are also called *personal computers*. At one time a microcomputer was a very limited type of machine with a slow CPU, little primary memory, and little software. However, over the past 15 years microcomputers have become increasingly powerful and are now hundreds of times as cost-effective as when they were first introduced in the general marketplace. The more powerful microcomputers of today far outperform million-dollar mainframe computers of two decades ago.

Battery-powered laptop and other portable computers are small enough to be easily carried. Laptops continue to increase in capability and in portability. It seems evident that we are at the beginning of a trend in which all students have their own computers rather than having to use computers in a lab.

Personal Digital Assistants (PDAs) devices were introduced in the early 1990s. They are more powerful than electronic organizers (EOs) but not as robust as a full-sized desktop computer. At this point they work well for taking notes and for smaller writing projects. They are small, lightweight, relatively inexpensive, and battery powered. Some of the more advanced units offer wireless networking and handwriting recognition—they have no keyboards; you just write on the display with the pen-like stylus. We are just at the beginning of the development of a vast consumer market for PDAs, and it is evident that these devices are useful to students.

## Hardware From a Storage Point of View

The trend is toward larger and larger storage capacity at lower and lower costs. The computer scientist appreciates the continued improvement in magnetic storage media such as hard disks, floppy disks, and magneto-optical disks. People interested in multimedia appreciate the progress in CD-ROM, laser disc, and digital recording of sound and video on magnetic tape. In all cases there have been massive improvements in the cost-effectiveness and in the ability to store a combination of text, still graphics, sound, and motion graphics in a form that a computer system can easily access.

Video and audio tape have long been used as noncomputer storage devices. Now, audio and video images can be digitized and used in a wide range of problem-solving tasks, including desktop publishing, portfolios, or electronic presentations. It is now quite common for students to use a tape recorder or camcorder to obtain materials that will be input to a computer. This audio and video input can be analyzed and edited using a variety of computer programs.

Compact Disk-Read Only Memory, or CD-ROM, is a storage medium for the computer. These are much like the CDs used to store music and other audio. A CD-ROM holds a very large amount of data. For example, an entire set of encyclopedias, every work by Shakespeare, hundreds of pictures or photographs, or large multimedia projects can be stored on one disk. A handfull of CD-ROMs can store more books than are found in many school libraries.

When reproduced in large quantity, it costs less than two dollars each to make copies of a CD-ROM. The future will bring us CD-ROMs

with greatly increased storage capacity. CD-ROM players will become commonplace in schools and in all places where there is need to access vast libraries of material.

New forms of CD players are beginning to emerge in the marketplace. CD-I is an ancronym for Compact Disc Interactive. CD-I is a new format of compact discs that allows users to interact with material on the compact disc. Kodak's Photo CD allows users to store still photos on compact discs instead of the traditional 35mm slide format. Up to 100 photos can be stored on a single disc. These color images can be viewed on either computer or TV monitors. CD players equipped to handle both these "multisession" discs and the single-session formats will become more prevalent. CD-ROM, CD-I, and Photo CD need to be part of the TAC's vernacular and equipment considerations.

A single videodisc can store tens of thousands of full-color still pictures or a substantial amount of video in a format that allows easy access to each individual picture or to any desired segment of video. The library of such materials that might be used in schools is steadily growing. A number of publishers now coordinate textbooks with videodiscs.

The overall trend is clear. The amount of information being made available to students through the computer-based storage systems discussed in this section is growing very rapidly. The modern library of today contains a vast amount of print materials, still graphics, sound, and video that has been digitized and can be retrieved through a computer network. Thus, schools need to help students learn to make effective use of these increasing amounts of information as an aid to learning, problem solving, and a wide range of other productive activities.

## Hardware From an Input/Output Point of View

The keyboard remains as a very important computer input device. It is supplemented by the mouse, touch screens, voice input, and a wide range of other general purpose and special purpose input devices. In the latter category are a number of devices designed to fit the needs of students and educators with a wide range of physical handicapping conditions.

There are many computer input devices that gather real-world data, such as radar data or data from a laboratory experiment, digitize it, and feed it into a computer. The microcomputer-based laboratory (MBL) is an important addition to science education.

Scanners can enter a photograph, a drawing, or a written page into the computer. Photos can be scanned, edited on the screen, and printed or

placed into a document. The text in a printed or typewritten page can be scanned and then translated into a word-processor file.

Digital cameras store pictures electronically onto a small magnetic disk instead of on film. The image can be loaded into a computer, edited, and printed. Images can be processed in black and white or color, depending on the particular capabilities of the camera and the computer system.

Frame grabber hardware can capture a frame from ordinary VCR videotape, digitize it, and store it in a computer's primary memory. It is now relatively inexpensive to digitize sound and motion graphics and to manipulate these types of data via computer.

Musical Instrument Digital Interface (MIDI) is a combination of hardware and software that converts musical sounds from microphones, keyboards, audio equipment, and drum machines into signals the computer can store. Music can be stored, edited, and played by a MIDI-equipped computer system.

Printers simply allow you to print what you create. Printers can be attached to a single computer or shared on a network. Various technologies are commonly used. The impact (dot matrix) technology is still widely used in printers. However, ink jet technology and laser technology are now commonplace. There is now a wide range of color printer technologies, and the cost of color printing is decreasing. Networking printers, using printer spoolers, and adding memory to each printer can increase the speed and efficiency of printers in a classroom or lab.

## Hardware From a Networking Point of View

A network is an electronic link between a number of computers. The link may be a combination of hard wire (direct connections), radio broadcast, and the various components of our worldwide telephone and telecommunications system. Thus, a school might network its own computer facilities by hard wire, communicate with various information sources by means of an uplink/downlink satellite dish, and tie into worldwide computer networks via the local telephone system.

In education, computer networks allow students and teachers to communicate with each other and with data banks of information. Students who are in different classes or even located in different parts of the world can work on the same project and share the data. They may work jointly on a writing and publication project.

Computer networks also allow hardware to be shared. For example, a CD-ROM drive, printer, or modem can be used by any person with

access to the network designed for such shared access. There can be special sections on the network that only certain students or teachers have access to.

Networks can be any size. A small network may involve just a few computers sharing a printer. A large network may connect hundreds of thousands of computers and other pieces of hardware. A small network is easy to design and maintain. Larger networks may be exceedingly complex, difficult to design, and difficult to maintain. A school or school district that is going to have a schoolwide or districtwide complex network will need to devote significant people resources to keeping it operational.

Groupware is a type of networked software that helps facilitate interaction among people working on a common project. For example, with an appropriate piece of groupware software, several people may simultaneously work on a project, each adding, deleting, and editing components, and each seeing the work of the others as it occurs. Networked systems may include a video and audio connection so that the people can see and talk to each other as they do the work. *Aspects* is an example of a collaborative writing tool for Macintosh computers linked to a common printing device or by a computer network. Students can write on the same document and collaborate via a "chat box" on the computer screen. Groupware facilitates collaboration among users by taking advantage of sharing screens and information over computer networks.

## Closing Remarks

Imagine a worldwide network of computer-based telecommunications linking people, databases, and libraries. Hundreds of libraries, thousands of large databases, and many museums are included on this network. Imagine artificially intelligent computer systems designed to interact with people to help them formulate, understand, and solve a vast variety of problems. Imagine students routinely using groupware as they learn to work cooperatively on large-scale problems that they deem relevant. Imagine an education system that immerses students in the routine use of such a system for learning, for learning to learn, and for demonstrating their knowledge. Students have free access to this system both inside and outside of school, at all hours of the day.

This vision represents where we are headed. While some progress has occurred, the overall field of networking for use in education is still in its infancy. Some schools are much further along toward achieving this vision for their students than are others. In all cases, a TAC can help to hasten the pace. It can help to ensure that today's children receive an education that appropriately prepares them for tomorrow's world.

HYPER
MEDIA

# Chapter 8

# Goals for Computer Technology in Education

*Discovery consists of seeing what everybody has seen and thinking what nobody has thought.*

*Albert von Szent-Gyorgyi*

*Do not follow where the path may lead. Go instead where there is no path and leave a trail.*

*Anonymous*

The TAC works to improve education, with special emphasis on uses of computer-related technology in curriculum content and teaching. In the strategic planning process (see Chapter 4), the TAC develops a list of goals and a plan for achieving the goals. This chapter contains a list of commonly agreed upon goals for education. It then gives a list of possible goals for computers in education. These can serve as a starting point for TAC discussion as it does strategic planning.

Material in this chapter comes mainly from Moursund and Ricketts' *Long-Range Planning for Computers in Education*. This book is listed in the Educational Computing section of Appendix 4.

## Goals of Education

It seems clear that we are at the beginning of a major change in education. The Information Age is upon us, and a number of educational trends and megatrends are beginning to reshape our schools.

Major change in education is a long, slow process that requires a great deal of effort on the part of people working to make the change. The intent of educational reform, of course, is to improve education. A starting point for the study of school improvement is to examine the missions of education. This discussion is intended to be suggestive rather than comprehensive. More than likely, different members of a TAC will have differing opinions on the relative importance of the goals listed below. They may suggest other goals that are not listed.

First, it is important to realize that education is a very large institution. As such, it has three underlying goals or unifying themes:

1. Life—Our school system as an "Institution" has had a long existence and seeks to preserve itself. Our educational system will strongly resist changes that threaten its existence.

2. Resource—A school system is a repository of knowledge and a vehicle for the dissemination of this knowledge. It consists of knowledgeable educators, libraries, school facilities, and pedagogical traditions. A school is a valuable part of the community in which it resides.

3. Service to Students—The bedrock goal, the basic mission, is that schools exist to educate students, to help students to learn and "grow."

These themes can be broken into a number of parts. The following list is a composite drawn from a wide range of literature sources. These Mission Statements (MS) are stated in a positive manner, as missions having been accomplished.

## Conserving Missions

MS1 Security: All students are safe from emotional and physical harm. A school is a safe, secure "home away from home" designed to promote learning.

MS2 Full Potential: All students are knowingly working toward achieving and increasing their healthful physical, mental, and emotional potentials.

MS3 Values: All students respect the traditional values of the family, community, state, nation, and world in which they live.

MS4 Environment: All students value a healthy local and global environment, and they knowingly work to improve the quality of the environment.

## Achieving Missions

MS5 Basic Information Skills: All students gain a working knowledge of speaking and listening, observing (which includes visual literacy), reading and writing, arithmetic, logic, and storing and retrieving information. The underlying orientation is to gain basic knowledge and skills useful in dealing with the full range of problem situations one encounters in life.

MS6 General Education: All students have appreciation for, knowledge about, and some understanding of:

- History and change.
- Nature in its diversity and interconnectedness.
- Religion, the professed relationships between humans and a deity.
- The artistic, cultural, intellectual, social, and technical accomplishments of humanity.

MS7 Lifelong Learning: All students learn how to learn; they have the inquiring attitude and self-confidence that allows them to pursue life's options.

MS8 Problem Solving: All students make use of decision-making and problem-solving skills, including the higher-order skills of analysis, synthesis, and evaluation. All students pose and solve problems, making routine use of their overall knowledge and skills.

MS9 Productive Citizenship: All students act as informed, productive, and responsible citizens, members of organizations to which they give allegiance, and to humanity as a whole

MS10 Social Skills: All students interact publicly and privately with peers and adults in a socially acceptable and positive fashion.

MS11 Technology: All students have appropriate knowledge and skills for using our rapidly changing Information Age technologies as well as relevant technologies developed in earlier ages.

## Computers in Education Goals (CEG)

The following is a list of goals for computers in education. Such a list of goals can be used as a starting point for long-range planning for computers in schools.

CEG1 Computer literacy (hypermedia literacy). All students shall be functionally computer literate (hypermedia literate). The redundancy in using the two expressions "computer literacy" and "hypermedia literacy" is to emphasize the changing nature of computer literacy in the past decade. Hypermedia literacy can be thought of as an extension of computer literacy. Functional hypermedia literacy can be divided into two major parts:

A. A relatively broad-based, interdisciplinary, general knowledge, to be achieved by the end of the eighth grade or earlier, of applications, capabilities, limitations, and societal implications of computers and other information technology. This has four components:

1. Talking and reading knowledge of computers and other information technology and their effects on our society. More specifically, every discipline that students study should teach them something about how electronic aids to information processing are affecting that specific discipline.

2. Knowledge of the concept of procedure, representation of procedures, roles of procedures in problem solving, and a broad range of examples of the types of procedures that computers can execute. Here the term *procedure* refers to a detailed, step-by-step set of directions that can be carried out by a computer or by a computerized machine.

3. Basic skills in use of word processing, database, computer graphics, spreadsheet, telecommunications, and other general purpose, multidisciplinary application packages. Basic skills in creating hypermedia materials as an aid to communicating and to storing and processing information.

4. Basic skills in computer input. Currently this focues on keyboarding, but in the future the emphasis may be on voice input, use of pen-based computer input devices, and effective interaction with virtual reality systems.

B. Deeper knowledge of computers and other information technologies as they relate to the specific disciplines one studies in senior high school. For example, a student taking advanced math courses shall learn about roles of computers in the math being studied. A student taking commercial art courses shall learn about roles of computers in the types of commercial art being studied. A student studying industrial arts should learn about computer-assisted design. A student taking science courses should learn about microcomputer-based laboratories and computer simulations in science.

CEG2 Computer-assisted learning (CAL). Schools shall use CAL to increase student learning and to broaden the range of learning opportunities. CAL includes drill and practice, tutorials, simulations, and microworlds. It also includes computer-managed

instruction (see Item C below). Eventually, CAL will include virtual realities designed for instructional purposes.

A. All students shall learn both general ideas of how computers can be used as an aid to learning and specific ideas on how CAL can be useful to them. They shall become experienced users of CAL systems. The intent is to focus on learning to learn, being responsible for one's own learning, and being a lifelong learner. Students have their own learning styles, so different types of CAL will fit different students to greater or lesser degrees.

B. In situations in which CAL is a cost-effective and educationally sound aid to student learning or to overall learning opportunities, CAL shall be made available to students. For example, CAL can help some students learn certain types of material significantly faster than conventional instructional techniques can. Such students should have the opportunity to use CAL as one aid to learning. In addition, CAL can be used to provide educational opportunities that might not otherwise be available. A school can expand its curriculum by delivering some courses largely via CAL.

C. Computer-managed instruction (CMI) includes record keeping, diagnostic testing, and prescriptive guides as to what to study and in what order. This type of software is useful to both students and teachers. Students should have the opportunity to track their own progress in school and to see the rationale for work they are doing. CMI can reduce busywork. When CMI is a cost-effective and instructionally sound aid to staff and students, they shall have this aid.

CEG3 Distance Education. Telecommunications, CAL, and other electronic aids are the foundation for an increasingly sophisticated distance education system. Schools shall use distance education to increase student learning when distance learning is pedagogically and economically sound.

Note that in many cases distance education may be combined with CAL so that there is no clear dividing line between these two approaches to education. In both cases students are given an increased range of learning opportunities. The education may take place at a time and place that are convenient to the student rather than being dictated by the traditional course schedule of a school. This "time and place" may include a student's home during nonschool hours.

CEG4 Applications. The computer as tool. The use of computer applications as a general purpose aid to problem solving using word processor, database, graphics, spreadsheet, and other general purpose application packages, shall be integrated throughout the curriculum. This is called computer-integrated instruction, or CII. The intent here is that students shall receive specific instruction in each of these tools, probably before completing elementary school. The middle school or junior high school curriculum, as well as the high school curriculum, shall assume knowledge of these tools and shall include specific additional instruction in their use. Throughout secondary school, students shall be expected to make regular use of these tools, and teachers shall structure their curriculum and assignments to take advantage of and to add to student knowledge of the computer as tool.

CEG5 Information technology courses. A high school shall provide both of the following more advanced tracks of computer-related coursework:

A. Computer-related coursework preparing a student who will seek employment immediately upon leaving school. For example, a high school business curriculum shall prepare students for entry-level employment in a computerized business office. A graphic arts curriculum shall prepare students to be productive in the use of a wide range of computer-based graphic arts facilities.

B. Computer science coursework, including computer programming, designed to give students college preparation for and a solid introduction to the discipline of computer science.

CEG6 Staff support. The professional education staff shall have computers to increase their productivity, to make it easier for them to accomplish their duties, and to support their computer-oriented growth. Every school district shall provide for staff development, and particular attention shall be paid to staff development needed to accomplish CEG1-CEG4 given above.

This means, for example, that all teachers shall be provided with access to computerized data banks, word processors, presentation software, computerized gradebooks, telecommunications packages, and other application software that teachers have found useful in increasing their productivity and job satisfaction. Computer-based communication is an avenue for teachers to share professional information. Every teacher shall have telecommunications and desktop presentation facilities in the classroom. Computer-

managed instruction (CMI) can help the teacher by providing diagnostic testing and prescription, access to item data banks, and aids to preparing Individual Educational Plans (IEPs). The now-common use of computers to help prepare IEPs for special education students provides an example of a computer aid for teachers.

CEG7 Long-term commitment. The school district shall institutionalize computers in schools. Instructional computing shall be integrated into job descriptions, ongoing budgets, planning, staff development, work assignments, and so on. The school district shall fully accept the idea that "computers are here to stay" as an integral part of an Information Age school system.

## Closing Remarks

Each of the CEGs can be related to the student-oriented mission statements. Perhaps the best way to summarize this is to point to the last mission statement, MS11: Technology. Students currently in school will spend their adult lives in the Information Age or what comes after the Information Age, with ever-increasing involvement with computer-related technology. The CEGs form the foundations for moving our schools into the Information Age.

A school-level TAC has the opportunity to influence the mission and goals of an individual school. A district-level TAC has the opportunity to influence the mission and goals of a school district. The CEGs are a good starting point for the discussion of facilities acquisition, staff development, and curriculum reform.

CSS '93

# Chapter 9
# Staff Development as a Change Agent

*One machine can do the work of fifty ordinary men. No machine can do the work of one extraordinary man.*

*Elbert Hubbard*

*Change is a journey, not a blueprint.*

*M. G. Fullen and M. B. Miles*

A strategic plan contains goals and plans for achieving the goals. The underlying idea is that the current situation is going to be *changed* into the desired situation. Appropriate use of technology in schools will require a great deal of change in curriculum content, ways of teaching, ways of assessing students, ways of evaluating teachers, and so on.

Change involves commitment, time, and risk. There are many vehicles for change in a school. Roughly speaking, they can be divided into three categories. A TAC must design an implementation plan that provides an appropriate balance among these three categories.

First, there are the changes brought about through easily purchased facilities or equipment, provided only that a school has enough resources. It is possible to build a new school, properly equip science labs, acquire large numbers of computers, expand the library holdings, and provide students with new textbooks. Each may contribute to students gaining a better education.

Second, there are changes that can be mandated. It is possible to develop rules, regulations, policies, and laws that require that schools be run in a certain manner, that students study certain topics, and so on. Many people feel that if the requirements are stated carefully enough and implementation processes are administered carefully enough, mandated changes can be successful.

Third, there are the changes that individual educators can bring about if they are able and willing to do so. These require that the staff have appropriate knowledge, skills, attitude, and resources to make the desired changes. To a very great extent, staff development is the key to

building a staff, individually and collectively, that can make desired changes.

There has been a great deal of research done on how to design and conduct staff development that will lead to actual improvements in schools. The research indicates that this is a long and costly process. For example, there is strong evidence to suggest that it takes three to five years of a well-coordinated and relatively intensive inservice effort to make a major schoolwide change in a school.

In a National Science Foundation-funded project, Moursund (1990) and a team of researchers developed a series of four inservice courses in the field of computers in education. Information on and materials for these courses are reproduced in the following four manuals published by the International Society for Technology in Education: *Computer Integrated Instruction Inservice Notebook—Elementary School, Computer Integrated Instruction Inservice Notebook—Secondary School Science, Computer Integrated Instruction Inservice Notebook—Secondary School Social Studies,* and *Computer Integrated Instruction Inservice Notebook—Secondary School Mathematics.* A substantial portion of this chapter draws from the literature reviews found in each of these four books.

Proposed changes should be rooted in careful research showing that the proposed changes have a good chance of improving education. Thus, a change might be aimed at improving the productivity of teachers or at improving the learning of students. A key concept in either case is transfer of learning. The goal is that the teachers and students learn in a manner that allows them to apply their new knowledge whenever and wherever it is appropriate to do so. Salomon and Perkins (1987, 1989) discuss low-road and high-road transfer. This theory of transfer of learning is particularly suited to the field of computer uses in education.

Helping educators improve their knowledge and skills is not as "flashy" as buying a lot of new equipment or building a new school, and it is not as quick as mandating that all students are to become computer literate or that they all are to take a particular computer literacy course. Staff development is a long, slow process. However, the ultimate quality of a school system depends on the quality of its staff. Many school restructuring efforts have failed due to inadequate attention to staff development.

In recent years, the business world has come to realize that its employees are its most valuable asset. Thus, businesses have given increased attention to staff development. IBM follows the rough rule of thumb that its employees need to devote about a month per year to staff development activities.

There is no precise formula for how much time per day, week, month, or year an educator should spend learning new things or participating in other staff development activities. Appropriate answers depend somewhat on the pace of change in the job situation. Technology changes very rapidly. Thus, in job situations where there is extensive use of technology, substantial time must be devoted to staff development. Technology in education is a very rapidly changing field, but the pace of change varies with different aspects of education.

Each TAC must deal with achieving an appropriate balance among recommendations that resources be put into staff development; that resources be put into hardware, software, and curriculum materials; and that new policies and rules be developed and implemented. In the past, most school districts have erred by leaning too heavily in the latter two directions. As a consequence, there is a tremendous amount of inappropriately used and under-used computer hardware and software in our schools. There are computer literacy courses that students are required to take but that are ineffective in improving the overall education the students receive. Staff development is absolutely essential for improving appropriate use of computer technology in schools.

## Effective Inservice Education

The remainder of this chapter focuses on school improvement through staff development, or inservice education. The references given at the end of this chapter are a representative sample of the extensive literature in this field.

There is a great deal of research on how to design and conduct effective inservices. Perhaps the most important idea is ownership. If the staff is involved in setting the goals for the inservice, designing the inservice, and (to the extent feasible) actually conducting the inservice, it will have a very good chance of being successful. Here, the word *staff* includes both teachers and school administrators. Since the purpose of the inservice is to help develop knowledge, attitudes, and skills that lead to change, it is absolutely essential that the school administrators be involved and be supportive of the change.

Change is not created by one-shot inservices. In meta-analyses done by Showers et al. (1987) and by Gall and Renchler (1985), one-shot inservices were found to be ineffective for long-term retention of the skill or knowledge. Follow-up done by coaching, feedback, and observations was deemed necessary for improving the effectiveness of an inservice.

By and large, if the only type of inservice that can be provided to staff is one-shot inservice, it would be better to not have the inservice at all and to use the resources for some other purpose. Put simply, a good inservice typically has multiple sessions spread out over a period of time, with opportunity to implement the new ideas between the inservice sessions. During these implementation times, good support must be available to the staff members. After the inservice ends, continued follow-up support must available. Follow-up may consist of team teaching, coaching, individual help, or further group inservice.

## Frequently Asked Questions

This section contains some of the questions people ask about the design and implementation of effective inservice for integrating routine use of computers into the classroom. The TAC can examine the inservice that the school and school district are providing to see which of the ideas from this section are being implemented. Most of the questions and answers that follow are from Moursund (1990).

**What is the most effective type of inservice?**

There are two general categories of inservice. First, there is the traditional large-group inservice. Here a group of teachers comes together in a class-like setting, and they receive instruction from an inservice facilitator. This can be successful if it is carefully done and if adequate follow-up support is available. There is a substantial body of research literature on how to design and conduct an effective large-group inservice.

A second approach, which is far more effective in the computer field, is one-on-one inservice conducted in the participant's school—indeed, perhaps even in the participating teacher's own classroom and demonstrating the desired behaviors with the participant's students. Most often in this case the inservice facilitator is a fellow teacher within the school building or school district. The overall activity may consist of the following sequence of events:

1. A teacher approaches the inservice facilitator and indicates a desire to learn. (Notice that this requires a high trust level, and building this trust level requires personal contacts.)

2. The teacher and inservice facilitator discuss the general area of desirable knowledge, attitude, and skills that might be expected as an outcome of working in this area, why it is important, how long it might take, what each might contribute to the process, and so on.

3. The inservice facilitator models the desired behavior, either in the teacher's classroom or with some other set of students. The teacher participates as a student.

4. The teacher spends time learning the skills through study and practice and receives the needed help from the inservice facilitator.

5. The teacher practices the desired behavior in his or her classroom, with the inservice facilitator serving as an assistant and as a source of feedback.

6. The teacher spends additional time studying the new material and lesson plans the inservice facilitator provides, and may work on modifying these lesson plans. Help is available as needed from the inservice facilitator.

7. The teacher tries out the new lessons in his or her classroom, gradually developing the self-confidence and skills needed to routinely use the new ideas and materials.

8. Additional help is available from the inservice facilitator as needed. The inservice facilitator gradually brings in new, higher-level ideas as the teacher makes progress and becomes ready for the additional ideas.

At first glance, this approach to inservice education appears to be much more expensive than the large-group, traditional approach. However, it is much more likely to produce the desired change in a teacher. Moreover, it is possible to organize a school's faculty so that this type of inservice is commonplace and may have very little cost. The idea is that every teacher in a school building should have some inservice responsibilities. That is, every teacher should have one or more areas of inservice expertise. As part of their professional responsibility, all teachers are to remain current in their inservice specialty areas and to provide one-on-one inservice to their fellow teachers. School and district inservice funds are provided to help each individual teacher develop and maintain his or her area of inservice expertise.

Some schools use this approach to inservice. It builds a high level of professionalism and collegiality. However, this approach to inservice is by far the exception rather than the rule. Thus, the remainder of this chapter focuses on traditional, large-group inservice.

**Is there a good model for an effective large-group inservice series?**

Here is a nine-part model that has proven effective. You may need to modify it to fit your own particular group-inservice situation.

1. Do a needs assessment. A number of needs assessment ideas are discussed in Moursund (1990). Many school districts have developed a long-range plan for computer use and a more general long-range plan for their schools. Such long-range planning provides a good starting point for a needs assessment.

2. Design the inservice and make the necessary arrangements for facilities. Give careful consideration to holding some or all of the sessions in the participants' schools.

3. Recruit participants. Keep in mind the desirability of having a critical mass of participants from each participating school, and the strong desirability of having administrative support and participation. By and large, it is easier to work with participants who have relatively homogeneous computer backgrounds and teaching interests.

4. Carefully and fully prepare the content of the inservice series. Prepare handout materials.

5. Do an inservice session. Conduct informal and formal formative evaluation as seems appropriate.

6. Participants should leave the inservice session adequately prepared to implement some change in their classroom.

   *Note*: Repeat 5 and 6 for each inservice session. Each session provides follow-up support to the previous sessions. Provide time in each session for doing the necessary follow-up support.

7. At the end of the inservice series, do some summative evaluation. From the participants' point of view, what went well and what didn't? What could be improved, and what changes in emphasis would make the inservice series more valuable to participants?

8. After the inservice series ends, continue to provide follow-up support to the participants.

9. Six months to a year after the inservice series ends, gather some data on the long-term residual effect of the inservice. Are the

participants exhibiting the behaviors that the inservice was designed to promote?

**What are some of the major failings in traditional large-group inservice for integrating the computer-as-tool into the curriculum?**

There are many flaws in the design of most such inservices. Here are a few of them:

1. The inservice is not based on an adequate needs assessment, with the needs assessment firmly rooted in long-range planning for computer use in schools. Frequently the school and school district lack a long-range plan for computer use. Thus, they lack the carefully considered and carefully designed long-term support of the key stakeholders who would be affected by increased use of computers in schools.

2. Often a one-shot approach is used, or there is only a very limited amount of inservice available. Research suggests that one-shot inservices are rarely effective. Change literature suggests that educational change takes a long time and substantial effort. Generally it takes a great deal more inservice than is provided, and it needs to be spread out over a period of years.

3. Most computer-integrated-instruction inservice does not provide adequate follow-up support. Only the "early adopters" (typically five to ten percent of teachers) tend to be able to take the results of a one-shot inservice with little or no follow-up support and actually make substantial changes in what they do in their classrooms. This is a very small percentage of teachers.

4. Most CII inservice focuses almost entirely on helping teachers learn to use the particular computer tool under consideration. Little or no time is provided to study needed changes in the curriculum, to learn to deal with new classroom organization and management situations, to develop and critique lesson plans, and so forth. The inservice focus tends to be on the "key presses" and details of using a particular piece of software rather than on underlying theory and higher-order thinking and problem-solving skills. The typical CII inservice would be more effective if it achieved a better balance between the lower-order skills (the key presses) and the higher-order skills (problem solving) inherent to the use of the software being studied.

5. Most CII inservices focus on single individuals (one person per school, or one per school district) rather than concentrating attention on a critical mass of teachers in a single school. It is

essential to define the educational unit of change (large department, a grade level, a school) and have a critical mass of inservice participants from that unit. The collegiality of a substantial support group contributes greatly to the successful implementation of what one learns in an inservice.

6. Most CII inservice does not have realistic expectations for desired outcomes. For example, an elementary school teacher is taught how to do process writing in a word-processing environment. But there are only four computers in that teacher's school. Or a secondary school math teacher is taught how to use a spreadsheet to present a variety of math topics and solve a variety of problems. But the computer lab in the teacher's school is at the other end of the building and is heavily scheduled for computer programming and computer literacy classes. Also, the school's mathematics instructional focus is dominated by the state-mandated standardized tests, and computers cannot be used on these tests. In both cases, the inservice has little chance of producing an educational change.

7. The nature and extent of the handout material is inadequate. Typically, the actual inservice time is quite short. Handout materials should be designed to help make maximum use of that time. Inservice participants are expected to carry what they are learning back to their own classrooms. Thus, sample lesson plans are important. Inservice participants are expected to continue to learn on their own after the inservice ends. The handout materials should facilitate further independent learning.

8. There is little or no direct support from the school administration or school district administration. Research strongly supports the contention that little classroom change is apt to occur without such explicit support. It is highly desirable that school administrators participate in the inservice alongside their teachers.

9. There are relatively few incentives for teachers to make substantial changes in their curriculum. But effective use of CII generally requires substantial changes in both the content and the conduct of the curriculum.

This list could easily be extended. The major point is that there is a lot of room for improvement. We should not be surprised by the fact that previous CII inservice has not been particularly effective in producing change in our schools.

**What is an appropriate balance between hands-on and off-machine activities in a CII inservice?**

Any inservice should be designed to accomplish specific educational objectives. If the goal is to change the classroom teaching behavior of the participants, then the inservice should be carefully designed to help participants learn the behavior that is expected of them and to practice the desired behavior.

For a CII inservice, the underlying goal is for participants to return to their classrooms and integrate tool uses of computers. This requires a change in course content and philosophy, as well as having students actually learn to use computers. Surveys of CII inservice participants suggest that they most prefer that approximately two-thirds to three-fourths of an inservice be spent in a hands-on mode. However, chances are that this is far too much time to spend in that mode. It leaves too little time for working on the changes in course content and underlying philosophy that are essential parts of the desirable classroom change.

Remember, a good inservice session includes most or all of the following:

1. An overview presentation of the general topic and underlying theory.

2. A demonstration of desired performance.

3. The oportunity for participants to learn to use the materials and to practice using them.

4. The chance for participants to discuss potential applications in their classrooms, to learn how the CII tool being studied fits in with their curriculum, and to learn how it leads to changes in their curriculum.

5. The opportunity for participants to practice working with materials they will use as they implement their new knowledge and skills in the classroom.

6. Follow-up activities.

A careful analysis of the above considerations suggests that there will often be a conflict between the desires of participants and the best judgment of the facilitator. The inservice facilitator should be aware that the inservice meeting time is actually quite limited, and the facilitator should therefore strongly encourage participants to do some of the needed computer practice on their own, outside of the formal inservice meetings times. However, the inservice facilitator should also be aware that teachers

are very busy and often have difficulty finding the necessary time to practice what is being covered in the inservice.

**How important is it that inservice participants develop collegiality and a peer support system?**

Collegiality and peer support are very important. Research suggests that inservice is more effective if it focuses on a specific educational unit, such as a large department, a school, or a school district, as a unit of change. Once a unit of change has been determined, it is very important to get the educators in that unit to work together to accomplish the change.

An important part of this is the long-range planning process. There, the key stakeholders are involved in developing a plan and doing some thinking about implementation. This can provide a start on the collegiality and peer support needed for long-term changes in our educational system. Even if the district does not have a comprehensive long-range plan for computer use, an individual school or even an individual department within a school can develop such a plan. This is a good thing to do because it will help contribute to the successful implementation of the ideas covered in your inservice.

We also know that teachers very much like to observe other teachers performing the desired behavior with students in their regular classrooms (they like to visit other teachers' classrooms or have other teachers come to their classroom and demonstrate). This is facilitated by having a number of teachers from a school involved in an inservice. The strong support of a school administrator can also help a great deal.

**How important is it to have school and district administrative support and participation?**

There is a substantial need for support from the school and district administration. The research on this is solid. The goal in a CII inservice is change in the participants' classrooms. But such change seldom occurs without the explicit backing of the school administration. This is one reason for doing long-range planning. The planning process requires active participation of administrators. The plan must be approved by top-level school administrators and the school board.

It is very clear that the school administration can play a strong role in fostering change. If a principal participates in an inservice, the principal will be thoroughly familiar with the classroom changes that are being advocated. The principal can then work with teachers to provide needed encouragement, support, and feedback to help them implement the desired change. Some of this may well be built into the evaluation of the teachers.

**What can we do to get the teachers involved who seem unwilling to learn new things or come to our inservices?**

All teachers are quite able to learn new things. Computers are not particularly difficult to learn how to use or to use. Certainly all teachers (after all, they are college graduates!) have the necessary intelligence.

Thus, the reasons for not participating are probably deep seated and difficult to address. At one end of the scale we have early adopters, and they quickly join any new and exciting movement. By now you have probably reached all such teachers in your school district. At the other end of the scale are the late adopters, and probably the best hope is that they will retire or quit teaching. There is a huge middle group of teachers who can be reached. But this takes time, patience, and considerable effort.

My first suggestion is to initially ignore the teachers who don't seem to want to get involved with computers. Spend your inservice efforts on those who want to be involved. You will experience far greater success, and gradually you will build up a cadre of teachers who can help you address the needs of teachers who are less quick to change.

There is no magical answer on how to reach the large number of teachers who are somewhat resistant to change. Peer pressure, one-on-one inservice, better incentives, administrative pressure, and so forth may all help. As these teachers see some of their colleagues making routine use of computers, they will gradually become more interested in doing so themselves. As more and more students routinely use computers, this will place pressure on the teachers who resist learning about computers. Given enough time and support, most teachers will learn to make effective use of computers in their classrooms.

Remember, computers lie at the very heart of some of the changes that are needed to move our schools into the Information Age. Nobody said it was going to be easy. There will be a continuing need for the type of leadership that good inservice providers offer. The computer field will continue to change very rapidly, so the job of the inservice provider will not be accomplished in the next decade or two. Keep at it!

## Evaluation of Inservice

As stated by Gall and Renchler (1985), "The evaluation of inservice programs is not a well-developed field," and "systematic evaluation of inservice programs is the exception rather than the rule" (p. 30). Gall and Renchler have identified four different levels at which inservice training might have effects. That is, an inservice program can be evaluated at each of these levels.

Level I: Implementation of the inservice program. (Measures of the quality of the training itself.)

Level II: Teacher improvement. (Measures of actual change in teacher behavior in the classroom.)

Level III: Change in student performance. (Measures of the degree to which improvements in teacher performance lead to improvements in student achievement.)

Level IV: Changes in the environment. (Measures of changes in the school that may be indirect—or even unintended—results of the inservice program.)

The further away we get from measuring the direct delivery of training, the less certain we can be that changes in Levels II, III, and IV are actually attributable to the training program. Other factors, unpredicted and unmeasured, may have greater impact than training. Typically, few inservice programs are evaluated at Levels III or IV, even though the ultimate goal underlying most inservice is to improve the quality of education that students receive.

## Closing Remarks

Currently, staff development is the major tool for implementing educational change. However, educational change through inservice education is difficult to achieve. Some of the difficulties include:

1. Change is multidimensional. We are dealing with change in a school system, and a school system is a very complex entity.

2. Change is a slow process. It is the nature of a stable and functioning system to resist change. School systems seem to be exceptionally resistant to change, and change only slowly.

3. Effective inservice is resource intensive. In many settings the resources available for inservice education may not be adequate to produce a significant change.

4. Learning styles of adults are complex. A typical inservice will involve adults with widely varying interests, characteristics, and backgrounds.

5. Global characteristics of school systems, many of which are outside the influence of the inservice provider, influence change.

6. Participation of teachers in the process of setting goals for inservice may enhance the learning of the participants, but it is difficult to properly achieve this participation in goal setting.

7. Mechanisms for evaluation of inservice programs are ill defined and infrequently attempted.

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# Chapter 10
# Final Remarks

*A journey of a thousand miles must begin with a single step.*

*Lao-tzu*

*The first step is the hardest.*

*Marie de Vichy-Chamrond,*

*Marquise du Deffand*

*The following editorial was written by Dave Moursund and first appeared in the October, 1991, issue of* The Computing Teacher. *Originally, the editorial was addressed to school-level technology coordinators. For publication in this book, it has been slightly modified to fit the needs of a TAC.*

## Now and 10 Years Ago

Think about some of the things you currently know about computers and the impact of computers in education. For example, you are familiar with graphical, icon-based, mouse-driven interfaces now in common use. You know that many microcomputers now have 2 to 4 megabytes of primary storage. You are familiar with relatively large and inexpensive hard disk systems; perhaps you use a microcomputer that has a 40-megabyte or 80-megabyte hard drive. You know that the CD-ROM and the videodisc have come into common use. You know that networks are frequently being installed in schools and that laser printers have come into common use.

You are familiar with a variety of generic computer tools, such as sophisticated word-processing, graphics, database, and spreadsheet packages. Perhaps you have used a variety of desktop-publishing and desktop presentation software. You may have used music composition and music performance software. Perhaps you are aware of the mathematical software that can solve a wide range of the types of problems students encounter in math courses.

You are familiar with integrated learning systems and the fact that they are selling very well. You know that a number of companies are

successfully developing and marketing a wide variety of educational software, and that the educational software industry is reasonably healthy. You know about hypertext, hypermedia, and the fact that a wide range of students can now produce exciting products in a hypermedia environment. You know that the fields of television and computing are beginning to overlap quite strongly.

Perhaps you have used an inexpensive graphing calculator that contains built-in functions that help to solve a wide range of math problems. Undoubtedly you have heard of "virtual reality," perhaps the ultimate in computer simulations. You are aware that Artificial Intelligence has made rapid progress in recent years, and that expert systems have come into common use as an aid to solving a wide variety of problems in business and industry.

Finally, you are aware that most teachers are not comfortable in using computers. Relatively few teachers routinely integrate the capabilities of current computer systems into their professional activities. It is a rare classroom in which students routinely use computers as an aid to problem solving and to processing information. To a great extent, progress in computer hardware and software continues to outstrip our staff development system.

## 10 Years Ago

Now imagine that you could retain all of your current knowledge as you were magically transported 10 years into the past. You are given the position of chair of the TAC. What decisions would you make and implement that would appropriately lead your school district into its future? How would you structure staff development? What hardware and software would you acquire? What changes would you attempt to make in the overall school curriculum? What policies would you help develop? What are common mistakes that schools have made in the past 10 years that you would avoid?

## Building the Future

Here are three things that seem particularly interesting about the above exercise. First, most of the hardware and software advances that have occurred in information technologies during the past decade were relatively easy to forecast. Most of the major ideas had already been developed more than 10 years ago. A person who was up to date on information technologies at the time and who understood simple forecasting techniques could have done a pretty good job of predicting what would become readily available.

Second, it is relatively difficult to accurately forecast the level of implementation of information technologies that will occur in schools. The

school market is quite a bit different than the ordinary consumer market. One reason for this is that the consumers, be they students or teachers, are not the ones providing the funds. The second reason is that many of the major decisions schools make are made for political reasons rather than being founded on a clear understanding of how best to improve the quality of education that students receive.

Third, major mistakes have been made, and some of them could have been avoided by more careful planning. Some mistakes have wasted a great deal of money. In many cases, inappropriate hardware and software have been acquired. In other cases, programs of study have been implemented and have (predictably) failed, due to inadequately trained teachers as well as inadequate facilities and materials.

Such mistakes have damaged the credibility of information technology leaders in education. The field has not delivered nearly as much as many of its proponents have promised.

### Recommendations

The field of information technology in education is in its infancy. The current and soon-to-be available hardware and software resources have the potential to make major contributions to the quality of our educational system.

The key issue is, will these potentials be reached? Will the current school reform and restructuring movements adequately address the potentials of information technologies? Can we, as leaders, successfully guide our educational system in dealing with Information Age technology? What are the best decisions to be making right now, and what are major pitfalls to be avoided?

School restructuring must be firmly rooted in a careful examination of the current state of the art of information technologies. This will provide us with very good insight into what information technologies schools can expect to have available during the next 10 years. The TAC must plan for the routine use of such technologies throughout the school curriculum.

## Closing Remarks

Most of today's schools look suspiciously like those of a hundred years ago. While changes in curriculum and teaching methods have occurred, the rate of change has been slow. Thus, the calls for school reform and school restructuring are firmly rooted in the observation that our school system has changed quite slowly relative to the pace of change of our overall society.

It is imperative that people will not be making similar statements a hundred years from now. Technology is substantially changing our world. Massive changes have occurred since the beginning of the Information Age in 1956. The pace of change is accelerating.

Educators now know a great deal about how to improve education. Educators who are also instructional technology specialists know a great deal about how to improve education through appropriate use of computer-related technology. Appropriately implementing modern theories of teaching and learning, and making appropriate use of technology, can substantially improve our educational system.

The TAC is in a unique position to facilitate school improvement that will help prepare students for life in our rapidly changing Information Age society. This position combines a bottom-up and a top-down approach. It involves the full range of stakeholders who are affected by and/or who are interested in school improvement. Through their individual and collective efforts, the members of a TAC can improve the quality of education our children receive.

# Appendixes

# Appendix 1
# Letters to Stakeholders

This appendix consists of eight editorials written by Dave Moursund, executive officer of the International Society for Technology in Education (ISTE). Each editorial is in the form of a letter addressed to a specific stakeholder group and is designed to inform members of that group why they should be interested in computer technology in education. The letters also suggest some actions stakeholders might take. The editorials were originally published in 1990-91 in *The Computing Teacher*.

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## Letter to Students

Dear Student:

This letter is about computers and your education. Let me begin by asking you a question. Why do we have schools? Think of some answers before you go on to the next paragraph.

One answer is that schools help you learn things that will help you function as an adult in society. Schools teach reading, writing, arithmetic, speaking, listening, learning to learn, and working with other people because these are important skills for adults. They were important to your grandparents and will be important to your grandchildren.

However, things are changing very fast in our world. The teaching materials and methods in schools are slow to change. So are the testing system and requirements. Teachers and school administrators are slow to change. For these and other reasons, schools aren't doing as good a job as most people would like. A different way of putting it is that you are getting cheated! Unless you are in a very special school, the chances are that you aren't getting nearly as good an education as you could be getting.

This letter focuses on just one part of your education—computer-related technology. The main reason our world is changing so fast is technology, and computers are an important part of that technology. Technology has produced airplanes, television, Nintendos, and life-saving medicines, as well as environmental problems and weapons of war that threaten our very existence.

Suppose that people were going to build a house with a deep basement. One way to dig the hole would be with hand tools like shovels and buckets. Another way would be to use heavy equipment like trucks and backhoes as powerful aids to the human body. You can think of reading, writing, and arithmetic as hand tools to aid in storing and processing information. Computers are power tools for the same purpose. There are many problem-solving and work situations in which a person who has access to a computer and knows how to use it has a massive advantage over people who don't.

Twenty-five years ago computers were quite rare and expensive. Now they are much less expensive, much more powerful, and commonly available. They are routine, everyday tools for millions of adults. Our schools have not done well in adjusting to this change.

In most schools, computers are still rare. (Do you have one to use whenever you want, both at school and at home?) Most teachers do not know how to use computers to solve the types of problems they are teaching you to solve. Even the most modern textbooks focus almost entirely on less powerful aids to storing and processing information. Most testing situations do not allow use of computers.

The result is that you are not learning to use computers as an aid to solving problems. This part of your education is not preparing you for adult citizenship in our society. There are a number of things you can do about it:

1. For each topic that comes up in a class, ask your teachers to explain the uses and limitations of computers in that topic area. If adults use computers in that area, ask why you are not being taught how to do the same.

2. Ask your parents and other adults how they see computers being used on jobs. Ask them to ask school officials why the schools aren't teaching you more about computers.

3. Learn to use a computer yourself. The chances are that your school has some computers, and you may have access to computers in other places. Make it into a routine, everyday, personal tool.

You are responsible for your own education. You know that computers exist and are a powerful aid to the human mind. You know that you are capable of learning to use this tool. You can make the decision to do so, and carry it out.

I would like to hear from you on your thoughts about learning to use computers and making everyday use of them in school. Please write.

Sincerely yours,

## Letter to Parents

Dear Parent:

Probably you have seen television reports or read articles that say our schools aren't doing too well. These reports are correct. Our children aren't getting nearly as good an education as we would like. This is especially true when it comes to learning how to use computers.

When I was a student, we didn't have computers in my grade school or high school. The computers that existed in those days were big, expensive, and hard to use. This was also probably true when you were in school.

Today, computers are much better and cheaper, and are readily available. Millions of people have computers on their desks at work and/or for use at home. It is hard for an adult to keep up with such rapid change. In many ways, it is much easier for children. They don't have to unlearn old ways of doing things in order to learn the new things.

Still, the chances are that your children are not learning much about computers in schools. "Not true," you say. "I know that my kids have used a computer." The trouble is, they aren't learning creative uses of computers as an aid to solving problems in all subjects. They aren't learning to make routine use of computers as an aid to their minds.

Let me ask you a hard question. Why do we consider reading, writing, and arithmetic to be the "basics" of education? Think about some answers before you read the next paragraph.

Reading, writing, and arithmetic are the basics of education because they are aids to the human mind. They help the human mind to store and process information, and to solve hard problems. Now a new mind tool—the computer— has been invented. It is an important addition to reading, writing, and arithmetic. Most of our schools, however, are doing a very poor job of helping students learn to use this new tool. It is easy to see why. Most teachers are like you and me—they did not learn to use computers while they were in school. Few textbooks assume that students

have good access to computers. Most tests do not allow students to use computers, and indeed, few students have computers to use.

Think about the last sentence for a minute. You would be very unhappy if your children did not have easy access to pencil and paper throughout the school day and as they did homework at night. For millions of adults, the computer is now equally important. They would not think of attempting to do their work without having a computer readily available. This will be even more true by the time your children become adults.

Most of our schools do not have nearly enough computers to allow students to use them whenever it would be appropriate. Even if the equipment were available in classrooms, most of our teachers lack the training to take advantage of it.

Ten or twenty years from now, most students will have easy access to computers. Every teacher will know how to work in a school setting where there are lots of computers. Students will be allowed to use computers when they take tests. (Why not? Adults are allowed—or required—to use computers when faced with the real-world tests they encounter on the job.)

Unfortunately, these developments may be too late for your children. There are some things you can do about this. Even a very few parents can cause a major change in a school by making their concerns clearly known to teachers, school administrators, and the school board. These are some of the questions to ask educators:

1. Are our children learning to use a computer to solve hard problems in all different subject areas, or are they mainly using computers to help memorize simple facts?

2. Do the teachers feel comfortable in routinely using computers for their work and with their students?

3. Do students get to use calculators and computers when taking tests? If not, why not?

4. Do students have to leave their classrooms and go to a lab to use computers ? (If so, they cannot make routine use of computers, and teachers cannot integrate routine computer use into the curriculum.) What are the school and district plans to make computers readily available for everyday use by all students?

Computers are a powerful aid to the human mind. However, it is still very important that students learn reading, writing, arithmetic, and

problem solving. All of these ideas and tools should be integrated together and used throughout the day in a modern education.

Let me know about the progress you make in working to improve the education of your children. Please write.

Sincerely yours,

## Letter to Teachers

Dear Teacher:

Being a teacher is a challenge even in the best of times. It is doubly difficult now, with tight budgets, increasing expectations, and very rapid changes going on in our society. These difficulties are compounded by the continued rapid progress of technology. Computers lie at the heart of much of this technological change, but our educational system is not doing very well in dealing with computer-related technology. In two previous letters I addressed what students and parents could do about this problem. Future letters will be addressed to curriculum coordinators, educational policy makers, and politicians. This letter focuses on teachers.

Have you ever wondered what it must have been like to be a teacher when reading, writing, and arithmetic were being invented? Surely this must have been a major challenge; it is not easy to learn to read, write, and do arithmetic. However, these skills have proven to be nearly indispensable aids to the human brain, and schools eventually adopted the goal of helping every student to master them. Methods were developed for the mass production of books, pencils, and paper so that all students and teachers could have easy access to these tools. Now, every teacher is expected to be reasonably proficient in the "basics" of education—reading, writing, and arithmetic. These educational changes occurred over a period of several thousand years.

These ideas closely parallel what is now going on with computers. Like reading, writing, and arithmetic, computers are a powerful aid to the human mind. Computers are also a powerful aid to instruction, and teachers are having to cope with computers. However, the time frame for this change is not millennia, but a single teaching career.

Here is a simple two-question self-test you can use to see how well you are coping with technology.

1. Do your students learn to make effective use of computers as an aid to exploration and to solving the problems that occur within the disciplines you teach? That is, are your students empowered by computers? (If your students routinely use multimedia, hypermedia, and computers, and if they are routinely evaluated in an environment that includes these tools, then your answer is "yes.")

2. Do you and your students make appropriate use of computers as an aid to teaching/learning the disciplines you teach? Specifically, are *you* empowered by computers?

If you answer "no" to either of these questions, you are letting your students down. The many reasons and excuses for "no" answers can be divided into two major categories. The first might be labeled, "It's someone else's fault." In this category we place excuses such as not having enough computers and appropriate curriculum materials, and not receiving enough staff development from the school district. The second category might be labeled, "It's my fault. I could do it if I would set my mind to the task, but ..."

Such fault-finding does not focus on the major issue. Many of our students are not learning to make effective use of computers as an aid to problem solving. They are not learning that computers are now inexorably woven into the very fabric of every academic discipline. Moreover, they do not routinely make use of computers as an aid to learning, even in situations where there is substantial evidence students would benefit greatly from such use.

There are two things you can do about this. First, exert pressure on your school administrators, school board, union, and school funding structure to work toward overcoming the first set of excuses. Enlist the aid of students and parents in this endeavor. A small group of students, parents, and teachers can produce a major change in a school system.

Second, you can accept the fact that you have a deep professional responsibility to become computer competent, that you owe it to your students to help them learn to make effective use of computers as an aid to problem solving and learning. You can begin immediately to fulfill this responsibility, and learn by doing.

Our educational system is at a major turning point, and you are a key player in the changes that are occurring. I challenge you, as a professional educator, to take a leadership role. Please write to me and share what you are doing.

Sincerely yours,

# Letter to Curriculum Coordinators

Dear Curriculum Coordinator:

Individualized instruction, cooperative learning, interdisciplinary and multidisciplinary studies, multimedia, hypermedia, computer-assisted instruction, and distance education—these are but a few of the combinations of new ideas in educational theory and educational technology that are challenging curriculum coordinators. These ideas could lead to substantial improvement in our school system.

This letter focuses specifically on computer-related technology in education. Perhaps the very essence of educational technology is that it empowers. Access to appropriate computer facilities and instruction in their use opens up new horizons to both students and teachers. This empowerment of students and teachers is perhaps best seen in classrooms where students and teachers work together in a hypermedia environment where they are supported by good access to information stored in a wide variety of formats, good access to tools that help process such information, and a cooperative, interdisciplinary approach to learning. The educational potential of computers suggests three specific questions for you, the curriculum coordinator.

1. Computers are a new field of study. What should students be learning about the field of computer and information science?

2. Computers are a powerful aid to problem solving in every academic discipline. One example is the storage, processing, and retrieval of information. What should students be learning about computers as an aid to problem solving?

3. Computers and other electronic technology lie at the core of hypermedia, computer-assisted instruction, intelligent computer-assisted instruction, and distance education systems that can be used to help deliver instruction. How can these instructional delivery systems be effectively used to help improve education?

Each of these is a very difficult question. You might say that it is the teachers' responsibility to answer them. However, each question is district-wide in scope, and no individual teacher can hope to cope with such questions alone. You might say that it is the superintendent's and the school board's responsibility to answer these questions. However, they lack time, detailed knowledge, and involvement with the daily content and pedagogy of the curriculum. The truth of the matter is that the curriculum coordinator bears major leadership responsibility in answering these questions.

So how well are you fulfilling your responsibility? Do you have a good understanding of what students should be learning about the field of computer and information science? A statement that all students should become computer literate hardly suffices. Does your school district offer the scope and sequence of the key knowledge and skills that all students should gain and well-thought-out options for students who want to go into this field in more depth?

The very fabric of many disciplines has been changed as computer tools have been woven in. Musical composition and performance, writing and publishing, graphics artwork, laboratory science, accounting and office practices, information retrieval, and a host of other vital activities in our society have all been drastically changed by computers. Are these changes reflected in the content of your school district's curriculum?

Computer-assisted instruction and distance education are new instructional delivery systems. There is a substantial body of research literature supporting their effectiveness in a wide variety of settings. Their use can have a major impact on both the students and the teachers in your district. Is your school district systematically exploring these aspects of instruction and making use of the findings to improve students' education?

Each of the three areas that I have discussed represents a major trend for change in education. Each of these trends requires careful planning, curriculum revision, teacher training, and changes in our instructional delivery system. Each school district needs a long-term plan specifying goals in this area and the steps to be taken to achieve these goals.

You, the curriculum coordinator, must play a key leadership role in developing and implementing these plans. I'd like to hear what you are doing. Please write to me and share your ideas and experiences.

Sincerely yours,

## Letter to School Administrators

Dear School Administrator:

You know that we face a crisis in the American educational system—a system designed about a hundred years ago for a society evenly balanced between agrarian and industrial interests. That time is long past. We have been in the Information Age since 1956. Combined direct

employment in agrarian and industrial manufacturing occupations is less than one-fourth of total employment in this country.

Do you know that more than one-fourth of all American workers have a microcomputer sitting on their desks? Many others have a computer terminal hooked to a mainframe system. Did you know that there is a general purpose microcomputer in more than one-fourth of all American homes? More than half of the purchasers indicate that the equipment is purchased for work-related purposes, and nearly half indicate that it is to help educate their children. The total number of microcomputers in American homes is 10 times the number used for instructional purposes in schools. American business and industry will install nearly twice as many microcomputers for its own use in 1991 as the total number of microcomputers currently being used in our schools.

This type of data is a small part of a growing picture that suggests that the school system is not adequately adjusting to the changing needs of society. There is a growing gap between the needs of a well-educated adult citizen and the average product of American schools. Solving this problem will take the combined resources and support of a large number of different stakeholders. In some sense, you stand in the middle of these stakeholders, with students, parents, teachers, and curriculum coordinators on one side, and business and government leaders on the other side.

Every educational administrator is faced by overwhelming demands on a limited amount of resources. The problem is to balance use of these resources to meet the demands of the stakeholders and to maximize the quality of education that students receive. Here are three major areas focusing on computer-related technology that you must address.

1. There is strong and growing evidence that appropriate integration of computer-based technology into schools can drastically cut dropouts, increase basic skills, and increase higher-order cognitive skills. A computer is a tool designed to aid "knowledge" workers, and every student is a knowledge worker. Eventually our schools should provide every student with easy and routine access to computer-related technology, both as an aid to learning and as an aid to solving a wide range of problems. Every school and school district should have a long-range plan for accomplishing this task. This plan should be developed by the combined efforts of all key stakeholders—parents, teachers, school administrators, local business people, and so on. These stakeholders must have ownership; it is absolutely essential that school administrators not make unilateral decisions about the acquisition and installation of computer-related technology.

2. There is growing evidence that school restructuring, including site-based management that better empowers teachers, leads to substantial improvement in schools. There is substantial literature on school restructuring. Key ideas include involving students and teachers in team-taught multidisciplinary activities, cooperative learning, removing the bottleneck of short 40- to 45-minute school periods that focus on a single subject, and making major changes in student assessment. (Standardized objective testing is a growing barrier to school improvement.) These types of school restructuring facilitate more effective use of computer-based technology.

3. Our current teacher certification and staff development system was designed to meet the needs of a very slowly changing world. The exponential rate of change in science, technology, and educational research in recent years has overwhelmed staff development systems. New, successful models for effective staff development have been developed. They are site-based, and they require that all teachers participate. Every teacher has personal and group responsibilities. The school is structured to help teachers meet these responsibilities. Staff development becomes an ongoing process, built into the everyday functioning of the school.

The rapid pace of change in society is a major challenge to school administrators. However, it also provides a unique opportunity for excellence in leadership to make a major difference. The International Society for Technology in Education has a mission of working to improve schools. If we can be of help to you, please contact us.

Sincerely yours,

## Letter to Teacher Educators

Dear Teacher Educator:

I classify myself as a teacher educator—as a teacher of teachers. I specialize in all aspects of computer-related technology in education. Often I am embarrassed to admit this, because I feel that our teacher education system is doing such a poor job in preparing teachers to deal with computer-related technology.

I routinely work with graduate students who know far more about the use of computer-related technology in schools than do their College of Education faculty. I teach in a College of Education where most of the teachers who graduate are not adequately prepared to deal with the

current level of use of computers in schools. I imagine that many of you face this same situation.

It surprises and saddens me that our teacher training institutions are doing so poorly in dealing with the onrush of computer-related technology. College faculty are bright, well educated, and strongly encouraged to keep up in their fields. However, on average they have failed in providing leadership for the major restructuring of our schools that is so sorely needed. There are many aspects to restructuring, and technology is only one component. For example, cooperative learning, multidisciplinary and team-based instruction, portfolio-based assessment, and site-based management are all quite independent of technology. However, all are facilitated by and facilitate use of computer-related technology.

Here are a couple of requirements that I believe the faculty of every College of Education should immediately lay upon themselves and their students.

1. Every preservice educator in a teacher training program should do at least one major multimedia project each term, where the multimedia include a range of computer-based technologies. We are rapidly moving toward a school environment in which all students will routinely do multimedia projects using computers, CD-ROM, videodisc, camcorders, VCRs, scanners, and other computer-related facilities. These students need teachers who are comfortable with and experienced in such a learning environment.

2. At least one term each year, and preferably each term, each teacher education faculty member should directly supervise a number of students who are doing multimedia term projects. Every faculty member must learn to help their students teach in a multimedia learning environment. It is not appropriate that faculty members should remain inept in the use of the tools that precollege students and their teachers routinely use.

3. Every College of Education faculty member and every preservice teacher should learn to make routine and effective use of computerized information retrieval and communication systems. Students and faculty should routinely communicate with each other via electronic mail. Computers are a powerful aid to problem solving and to information storage, processing, and retrieval. Many problems can be solved by retrieving information about how someone else has already solved similar problems. Many problems can be solved by appropriate use of information that is now stored in computerized databases. In these and other ways, computers bring a new

dimension to problem solving and are a unique new aid to higher-order cognitive processes.

4. At least once each year, and preferably once each term, each teacher education faculty member should present a unit of study in which the primary mode of instruction is computer-based multimedia. We know that teachers teach in the way that they were taught. Without appropriate role models, preservice teachers will continue the pattern of instruction that currently exists in our schools. College of Education faculty must provide leadership in breaking this pattern.

5. Every College of Education should provide its students with substantial experience in learning from and teaching with Integrated Learning Systems and distance education. Computer-assisted learning and distance education are powerful additions to our instructional delivery system. We must prepare teachers to make appropriate use of this technology.

Almost every College of Education already has enough computer-related facilities to implement the above ideas. Many have adequate faculty to quickly bootstrap themselves into implementation of these ideas. Others will need to make extensive use of computer-knowledgeable teachers from local schools.

The International Society for Technology in Education has a mission of working to improve our educational system. This professional society stands ready to help you as you work on dealing with the types of issues addressed in this letter.

Sincerely yours,

## Letter to Business People

Dear Business Person:

Did you know that approximately one-half of the work force in the United States has easy and routine access to a microcomputer or a terminal tied into a mainframe computer system? Did you know that more than one-fourth of United States households have a general purpose microcomputer? (This does not count the 40 percent that have a Nintendo!) More than half of these home computers are purchased for work-related activities, but there is also a very strong emphasis on educational uses.

Contrast these figures with the one computer workstation per 20 students that is average for the precollege education system in the United States. Factor in the fact that most teacher training programs lack adequate access to computer-related technology and the resources to prepare their faculty to use such facilities. Based on such data, it is not surprising that American business and industry are unhappy with the products of our educational system. The world of business and industry is changing very rapidly, but our educational system is not designed or funded for rapid change.

The private sector has recognized that it has a vested interest in improving our educational system, and it has much to contribute to that effort. The number of education-business partnerships has grown markedly in the past few years. Typically, when a school or school district enters into a partnership with the private sector, its primary underlying thought is acquiring resources such as equipment and money. However, the private sector cannot donate enough resources to modernize our educational system. Resources from the private sector can help, but there are other, more important things that these education-business alliances can accomplish. For example:

1. Locally, regionally, and nationally the private sector should insist that we have a high-quality educational system. The typical American student does not believe that doing well in school will lead to getting a good job. American business and industry could lead to substantial improvement in our educational system merely by publicizing that they give preference in hiring to better students, and then actually give them such preference.

   It is evident that the private sector places major emphasis in the quality of the school system when they are considering the creation of new corporate sites or major movements of staff. This should be widely publicized, and sites that do not measure up should learn about their deficiencies. Nationwide publicity on the desired standards would do much to raise the overall standards for education that are being set throughout the country.

2. The private sector has come to understand the benefits of empowering workers, of using quality circles, and of reducing the number of levels of management. It understands accountability and responsibility in a manner that is quite different from that used in most of our schools. Education-business alliances should focus on helping schools to use these modern business practices.

   Businesses compete; if they do not compete successfully, they go bankrupt. To a very large extent, schools do not compete, and there are few penalties for failure to compete. We cannot allow local school

systems to have a large school dropout rate and to produce unemployable graduates. The private sector must help local educational leaders and taxpayers understand the standards that are needed for employment, and they must insist that these standards be met.

3. The private sector has far exceeded our education system in learning to make appropriate use of computer-related technology. Appropriately designed education-business partnerships can provide both students and educators with a window into a world that is new, exciting, and challenging.

The typical worker who needs to make use of a computer has ready access to such facilities. As a rough estimate, there will be twice as many microcomputers and computer terminals installed in the private sector during 1991 as the total installed base used in all of our precollege schools for instructional purposes. Much of the equipment in schools is antiquated. The gap between what goes on in the classroom and what goes on in business and industry is growing. To a large extent, teachers and school leaders are not aware of this massive and increasing technological gap between schools and the private sector. Education-business partnerships can focus on education of teachers, educational leaders, and school board members.

The International Society for Technology in Education has a mission of working to improve our educational system. This professional society stands ready to help you as you work on dealing with the types of issues addressed in this letter.

Sincerely yours,

## Letter to Government Officials

Dear Government Official:

More than a hundred years ago, the United States set about to create a system that would provide basic educational opportunities to all children. We were reasonably successful, and the system served our country well. It accommodated millions of immigrants; it helped us become a world power and the world leader in science and technology.

Sadly, relative to our needs, the quality of our educational system has eroded badly over the past two decades. The educational demands being

placed on our adult citizens have grown rapidly, outpacing progress in our educational system.

Now, about one-fourth of our students are dropping out of school. Many others graduate with totally inadequate basic skills and higher-order thinking skills. They are not prepared to deal with the pace of change in society or to solve the types of problems they encounter at home, at work, and at play.

This educational crisis cannot be solved by actions of state and federal government leaders alone. However, such leaders can and must play a major leadership role. Here are a few examples of things you should be doing:

1. Confront and solve the financial equity issue. There are many school districts that have a per-pupil budget of less than half of the national average. These school districts cannot afford to have adequate facilities and to adequately pay their teachers. They have difficulty in attracting qualified teachers, and they cannot afford the staff development expenses to maintain the quality of their staff. This financial inequity is particularly troublesome as our schools work to provide students for adult citizenry in the Information Age. Computers and computer-related technology are simply too expensive for many schools. Equal access to technology is an absolutely essential aspect of addressing the issue of equity in education.

2. To a large extent, our educational system is driven by assessment or testing instrumentation. Standardized objective tests may have been adequate to fit the needs of a school system focusing on minimal basic skills. However, our current testing system is totally inadequate to deal with the higher-order thinking skills, cultural diversity, and rapidly changing technological aspects of a good modern school system. For example, suppose that a school places great emphasis in having all of its students become adept at writing using a word processor and in using a computerized information retrieval system as an aid to solving problems. It seems only logical that these students should have access to such computer facilities when taking state, national, and college entrance tests. Sadly, such is not the case.

3. Distance education is bringing a new dimension to our educational system. Both students and teachers can receive instruction beamed over the airways. Students in a small rural school can have the opportunity to take a physics course or study Japanese, even though the school does not have teachers in these subjects. Teachers can be given access to a wide range of staff development opportunities.

Often such instruction is provided by instructors located in another state or perhaps even another country. Currently there are innumerable local and state political and regulatory barriers to distance education. These can only be removed by state and national action on the part of regulatory and governing bodies.

4. On a nationwide basis, our teacher training institutions are woefully under-funded. They do not have the resources to acquire the facilities and train their staff to provide a modern introduction to technology in education. At both the state and the federal level there is a crying need to redirect some of the funds that are going into education.

5. One of the most powerful messages that has come from business and industry is that workers are more productive when they are empowered. Quality circles and site-based management are very successful. Our schools and school systems have been slow to adopt these ideas of empowering teachers and students.

6. Every state faces the issue of state versus local control of schools and the school curriculum. There is powerful evidence that education can be improved by an appropriate balance between site-based management that empowers teachers, and statewide standards for appropriate accountability. The United States as a whole must move rapidly toward national standards of accountability.

While this list could easily be extended, the message should be clear. Governmental leadership at the state and national level must address major issues such as inequities in access to technology and quality education. They must invest in the future of our educational system by providing better funding for teacher training programs. They must insist on all students having good access to a high-quality educational system. The International Society for Technology in Education has a mission of working to improve our educational system. This professional society stands ready to help you as you work on dealing with the types of issues addressed in this letter.

Sincerely yours,

# Appendix 2
# Sources of Funding for Technology

Change, such as school reform and school restructuring, requires resources. The resources needed include a combination of money, the time and energy of people, leadership, and a wide range of other types of resources. This appendix addresses some of the potential sources of the financial resources needed to help trigger significant educational change.

Every school and school district has some internal financial resources that can be directed toward technology. If these resources are carefully identified and if they are used according to a well-thought-out plan, they can serve as the basis for significant educational improvement.

Dave Moursund likes to tell stories about some consulting he did for a large school district in the early 1980s. He facilitated a two-day retreat for a number of the top-level school administrators and computer leaders. One of the major focuses was on the need to make a permanent, line-item commitment to funding computer technology. Moursund suggested that 2 percent of the school budget needed to be committed to this purpose. At one stage in the discussion, the superintendent leaned over to the finance officer for the district and asked, "Can we come up with 2 percent?" After about a minute of thought and rapid calculation on a piece of paper, the answer was, "Yes."

Every school district has financial resources that it can redirect to computing if it decides that computing is of high enough priority. In addition, there are many other sources of funds. This appendix summarizes a number of other types of financial resources that may be available to a school or school district. The TAC should consider these resources as it does long-range planning for technology in the schools.

## Federal Funds

Surprisingly many of the computers in today's schools were acquired through federal funds. The more standard and prevalent sources of federal funding are Chapter 1 and Chapter 2 grants. Chapter 1 funds are dedicated to meeting special needs of math and reading students in Grades 1-8. Chapter 2 funds are block grants directed at novel projects in schools and districts. Through either of these sources, schools can find monies to fund technology purchases that are related to special needs students or larger projects, such as desktop publishing, that use computers or other technology.

Substantial federal funds are available through the Dwight D. Eisenhower Mathematics and Science National Program, which focuses on innovative projects directed at schools with a large percentage of low-income families. This program is a valuable source of funds for staff development.

The Education for the Handicapped Act (PL 94-192) provides federal dollars to districts with qualifying special education students. The Carl Perkins Act provides for federal funds for vocational instruction. These funds can provide students and schools with additional revenue to incorporate technology in an overall strategic plan. Most of these grants, however, contain strict guidelines on the uses of equipment purchased.

In the past, use of computer facilities acquired through the various federal programs has tended to be carefully restricted to the particular group of students for whom the federal program was intended. This has led to rooms of computers sitting unused during certain parts of the day. More recent federal legislation has loosened these rules, making possible more widespread use of computer facilities purchased under various federal programs.

## State Funds

Every state is interested in school improvement. Every state participates in the national governors' meetings that focus on education. Every state has a computer coordinator or technology coordinator who helps provide statewide leadership in this field. A TAC should establish contact with this state leader and inquire about possible sources of funding.

In the United States, approximately 10 percent of the cost of public education comes directly from the federal government. Most of the rest of the funding comes from a combination of state and local resources. In some states, nearly all of the funding comes from the state, while in others, the great majority is from local funding sources. In all states, the TAC should examine the nature and extent of state resources being allocated for technology. Many schools and school districts do not obtain available resources at a state level because they are not appropriately organized to write the proposals and actively seek these funds. A TAC can help overcome this difficulty.

State legislatures are a source of considerable funding for public schools. Legislatures are often overlooked by educators as being too complex or too removed from school operations. Legislators and governors, however, yield broad control over school finances. In most states, special grants or appropriations are formulated to help schools purchase Information Age technology. The TAC might develop a strategic

plan that directs action toward the legislative and administrative branches of a state government. Such actions might include lobbying in the legislature as individuals or groups for funding aimed at educational technology; sponsoring a "Computer Day" at the State Capitol, with student demonstrations and media coverage; or promoting community letter-writing campaigns aimed at expressing support for increased funding of technology in the schools.

The TACs from a number of schools and school districts might want to organize a statewide meeting, perhaps in conjunction with a regularly scheduled statewide conference for technology in education. Key state leaders might be invited to participate in the meeting. One goal could be to increase state funding for technology.

## Partnerships

Partnerships between schools and businesses or other institutions are now common. There is a growing literature on the types, strategies, and sources of partnerships. Originally, many educators viewed partnerships as providing quick and easy access to funds from corporations seeking good publicity and tax write-offs. We know now that partnerships involve complex relations between schools and other institutions, such as businesses or universities, which must be mutually beneficial for long-term success to occur. It is better to think about partnerships as long-term investments geared to intrinsic and extrinsic needs rather than merely as quick fixes.

A TAC includes representatives from local business and industry. Typically, the schools and school district will already be participating in partnerships with business and industry. However, often these partnerships are not part of a coherent long-range plan for school improvement, and these partnerships do not contain a specific focus on increasing the appropriate use of technology in schools.

There is a wide range of things that partnerships can do besides providing financial resources. High-tech summer jobs for teachers and students are a good example. Many communities now provide for such hands-on experiences for teachers and students who want to learn about real-world uses of computer technology. Partnerships can also be a valuable vehicle for developing apprenticeships for students.

Partnerships can provide needed publicity and "authenticity" for a TAC. They can provide space for TAC meetings. A high-tech meeting facility can help demonstrate to TAC members the sense of direction the computer field is taking and can add to their knowledge of computer technology.

## Foundation and Corporate Giving

Roughly speaking, foundation and corporate giving can be divided into three major categories. First, almost every corporation has provisions and resources to help the communities in which it functions. Typically, the corporation is interested in improving the community and the schools within the community. The TAC should make contacts with local corporations and engage them in helping to design and implement a long-range plan for school improvement. Often a partnership arrangement, involving both the corporation itself and the corporation's giving arm, should be sought.

Second, there are regional foundations that often disperse funds initially coming from a single individual or corporation. These foundations engage in a wide range of activities, but typically are most interested in activities that have a regional impact. Often, a proposal that will have strictly a local impact has a hard time competing with a proposal that will have a statewide or multistate impact.

Third, there are the national or international foundations. Most of the top foundations in America provide cash grants for projects dealing with educational activities. Each foundation has unique application requirements and commitments to educational improvement. Grant requests must take into consideration the goals of the foundation and the guidelines set forth in the application process. Since such foundations receive a very large number of requests for funds, proposals need to be carefully designed and must support both the specific goals of the foundation and its national or international scope.

## Grant Writing

For the most part, there is substantial competition for local, regional, state, and federal funds that can be used in education. It is not uncommon for a funding agency to receive several hundred proposals for each proposal that can be funded. This strongly suggests:

1. A TAC should pay very special attention to local sources of funds. There the competition will be local and the chances of writing a successful grant may be much higher than in a statewide or national competitive program.

2. Many school districts employ professional grant writers. There are many books on grant writing. (Check your local library or a comprehensive bookstore.) It takes a great deal of time, effort, and skill to be competitive in grant writing at the national level.

3. One can gain a major competitive advantage in grant writing to corporations and foundations by having personal contacts with some of the key people at the corporations or foundations. The broad-based membership of a TAC can be immensely helpful in this endeavor.

## Sources of Information About Funding

*Education Week*. 4301 Connecticut Avenue, NW, Suite 250, Washington, DC 20008. (202) 364-4414.

A weekly newspaper detailing news and newsmakers in education. Informative articles, opinions, and statistics about the nation's schools and educators. Frequently contains news about grants awarded and details federal projects and funding. Published 40 times a year.

*The Federal Register*. Office of Federal Register, National Archives and Records Administration, Washington, DC 20408.

The official record of the federal government. It provides information about federal grants and legislation affecting education.

*The Foundation Directory*. The Foundation Center, Room 312, 312 Sutter Street, San Francisco, CA 94108. (415) 397-0902.

A biannual directory of key foundations across the country. The Foundation Center is a clearinghouse for many foundations. It is the best place to begin searching for information about funding from foundations.

*Foundation News*. Council on Foundations, Inc., 1828 L Street, NW, Washington, DC 20036. (202) 466-6512.

A magazine published twice a month featuring issues that are relevant to foundations or organizations whose projects have received grants. This publication details corporate funding of projects across the world, provides information on laws and rules about funding, and gives current information on other aspects of foundations.

*Education Funding News*. Education Funding Research Council, 1611 North Kent Street, Suite 508, Arlington, VA 22209. (703) 528-1000.

A newsletter providing up-to-date information about funding opportunities for schools and communities.

*The USLDA Funding Sourcebook for Distance Learning and Educational Technology.* Arlene Krebs, United States Distance Learning Association, P.O. Box 5129, San Ramon, CA 94583. (800) 829-3400.

An annotated guide to foundations that tend to focus on distance learning and educational technology. This sourcebook offers a wealth of information on many facets of funding.

## Foundation Addresses

The following 28 foundations have supported technology in education in recent years. More information on these funding sources can be found in the USLDA Sourcebook described above.

| | |
|---|---|
| Annenberg/CPB<br>901 E. Street NW<br>Washington, DC 20004<br>202-879-9640 | W.K. Kellogg Foundation<br>400 North Avenue<br>Battle Creek, MI 49017-3398<br>616-968-1611 |
| The Annenberg Foundation<br>St. Davids Center, Suite A-200<br>150 Radnor-Chester Road<br>St. Davids, PA 19087<br>215-341-9270 | Kresge Foundation<br>3215 West Big Beaver Road<br>Troy, MI 48007-3151<br>313-643-9630 |
| AT&T Foundation<br>550 Madison Avenue, Room 2742<br>New York City, NY 10022-3297<br>*For application guidelines:*<br>P.O. Box 1430<br>Wall, NJ 07719<br>212-605-6734 | Lily Endowment<br>2801 North Meridian Street<br>PO Box 88068<br>Indianapolis, IN 46028<br>317-924-5471 |
| Benton Foundation<br>1710 Rhode Island Ave., NW, 4th Fl.<br>Washington, DC 20036<br>202-857-7829 | The John D. and Catherine T. MacArthur Foundation<br>140 South Dearborn Street<br>Chicago, IL 60603<br>312-726-8000 |

| | |
|---|---|
| The Blandin Foundation<br>100 Pokegama Avenue North<br>Grand Rapids, MN 55744<br>218-326-0523 | The John and Mary R. Markle Foundation<br>75 Rockefeller Plaza, Suite 1800<br>New York, NY 10019-6908<br>212-489-6655 |
| Carnegie Corporation of America<br>437 Madison Avenue<br>New York, NY 10222<br>212-371-3200 | The Andrew W. Mellon Foundation<br>140 East 62nd Street<br>New York, NY 10021<br>212-838-8400 |
| The Danforth Foundation<br>231 South Bemiston Ave., Suite 580<br>St. Louis, MO 63105-1903<br>314-862-6200 | Charles Stewart Mott Foundation<br>1200 Mott Foundation Building<br>Flint, MI 48502-1851<br>313-238-5651 |
| Geraldine R. Dodge Foundation<br>95 Madison Avenue<br>P.O. Box 1239<br>Morristown, New Jersey 07962-1239<br>201-540-8442 | The National Foundation for the Improvement of Education<br>1201 16th Street, NW<br>Washington, DC 20036<br>202-822-7840 |
| Exxon Education Foundation<br>225 East John W. Carpenter Freeway<br>Irving, TX 75062-2298<br>214-444-1104 | Panasonic Foundation<br>One Panasonic Way, 3G-7A<br>Secaucus, NJ 07094<br>201-392-4131 |
| Ford Foundation<br>320 East 43 Street<br>New York, NY 10017<br>212-573-5000 | The Pew Charitable Trusts<br>Three Parkway, Suite 501<br>Philadelphia, PA 19102-1305<br>215-568-3330 |
| Freedom Forum<br>1101 Wilson Boulevard<br>Arlington, VA 22209<br>703-528-0800 | RJR Nabisco Foundation<br>1455 Pennsylvania Ave., NW, Suite 550<br>Washington, DC 20004<br>202-626-7200 |
| General Electric Foundation<br>3135 Easton Turnpike<br>Fairfield, CT 06431<br>203-373-3216 | Alfred P. Sloan Foundation<br>630 Fifth Avenue, 25th Floor<br>New York, NY 10111-0242<br>212-649-1649 |

| | |
|---|---|
| GTE Foundation<br>One Stamford Forum<br>Stamford, CT 06904<br>203-965-3620 | Texas Instruments Foundation<br>PO Box 655474, M/S 232<br>Dallas, TX 75265<br>214-917-4505 |
| The Hitachi Foundation<br>1509 22nd Street NW<br>Washington, DC 20037<br>202-457-0588 | DeWitt Wallace-Reader's Digest Fund<br>261 Madison Avenue, 24th Floor<br>New York, NY 10016<br>212-953-1201 |

# Appendix 3
# People, Places, and Projects

## America 2000

In the early 1990s, President George Bush and the 50 state governors presented the country with a set of goals for America's education system to be accomplished by the year 2000. These goals are the basis for a broad federal effort called "America 2000." Communities and schools are encouraged to adopt the America 2000 goals and work at a grassroots level to implement the changes locally.

Towns, cities, and neighborhoods can become an America 2000 community by: 1) adopting the six National Education Goals, 2) developing a community-wide strategy to achieve them, 3) designing a report card to measure the results, and 4) planning and supporting a New American School (see the NASDC Contacts section below). States are being asked to support these local changes with state policy and regulations.

### The National Education Goals

The national goals listes in *America 2000* are that by the year 2000:

1. All children in America will start school ready to learn.
2. The high school graduation rate will increase to at least 90 percent.
3. American students will leave grades 4, 8, and 12 having demonstrated competency in challenging subject matter including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy.
4. U.S. students will be first in the world in science and mathematics achievement.
5. Every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship.

6. Every school in America will be free of drugs and violence and will offer a disciplined environment conducive to learning.

For more information or a free booklet on the America 2000 program, contact the U.S. Department of Education (1-800-USA-LEARN). In the D.C. Metropolitan Area, call 202-401-2000.

## NASDC Contacts

The New American Schools Development Corporation (NASDC) is a private, nonprofit, tax-exempt organization formed by American business leaders to support the design and establishment of new high-performance learning environments that communities across the country can use to transform their schools for the next generation of American children. The material in this section is taken from an undated report, *NASDC Facts*, distributed in the fall of 1992. It is produced and distributed by NASDC, 1000 Wilson Blvd., Suite 2710, Arlington, VA 22209; phone (703) 907-9500. The report describes NASDC as follows:

> NASDC is an unprecedented national effort to bring America's creative genius to bear on one of the most pressing challenges before this nation: creating schools that will help all American students make a quantum leap in learning, and that will restore American education to world preeminence. ...NASDC's success lies not in incremental reform or cosmetic changes in existing school structures, but in the creation of new schools, and new ways of teaching and learning, for a new millennium.

A broad-based solicitation of proposals offered first-year funding to prospective design teams. According to the guidelines for proposal writers, the proposed new schools to be developed through the projects

> must help all students meet new national standards in five core subjects of mathematics, science, English, history, and geography, and must prepare students for responsible citizenship, further learning, and productive employment. They must be able to operate on a budget comparable to conventional schools. They must seek fundamental institutional change in American schooling.

In the summer of 1992, 11 winning organizations were chosen from 686 proposals. These organizations will do further work on their "break the mold" models over the next year. They received funding for one year to "further develop and refine their prototypes for the best schools in the world." The intent is to provide further funding to some of the design teams in order to actually implement their proposed designs. Many

educators and vendors will be closely following the results of these NASDC grantees.

A list of the 11 winning design team projects is given below. Notice that 10 of the 11 projects place explicit emphasis on use of computer technologies.

## Atlas Communities

ATLAS Communities: Communities for Authentic Teaching, Learning, and Assessment for all Students. Lancaster, PA; Norfolk, VA; Prince George's County, MD; Groham, ME.

Theodore Sizer
Coalition of Essential Schools
Brown University
Box 1969
Providence, RI 02912
401-863-3384

ATLAS Communities will focus on authentic education, the concept that children learn best in environments they know; and the concept of community, including homes, schools, cities, and small personal groups. The ATLAS vision is build around six dimensions crucial to school reform: authentic and sustained learning environments; supportive organizational structures; broader communities; ongoing development of educators; facultative uses of technology; and flexible administrative and financing policies. ... Technology resources will be used in two principal ways. First, technology-based programs will be used to enrich curriculum, assessment, and adult development activities. Second, state-of-the-art technology will be used to facilitate communication among all participants within and across sites and organizations.

## Bensenville Community

The Bensenville, Illinois, Community Design for a New Generation of American Schools.

Sharon Probloske
Bensenville Intergovernmental Group
700 West Irving Park Road
Bensenville, IL 60106
708-766-8200

The Bensenville Community Design story exemplifies the role of community in education reform. In 1991, this village of 17,000 people

outside of Chicago, Illinois, resolved that they must redesign their schools if their children were to compete in the global economy. The citizenry met regularly, educating themselves about the future, educational theory, and school funding. Design team members run the gamut from the village manager and the school superintendent to the local pharmacist and the president of the Fenton High School Student Council. The plan is to create an environment where the entire community serves as a campus. At the heart of the community will be a Lifelong Learning Center. Non-traditional learning sites, such as government offices and industrial complexes, will become classrooms as well. Students will take a more active role in classroom learning, and teachers will become facilitators who draw the varied resources of the community into their classrooms. Using technology will become as familiar to students as using pencils. ...The teacher's desk will be replaced by an Electronic Teaching Center, which will include a file server connecting the teacher to the computers used by the students. At this center, the teacher may monitor student achievement data, create and print relevant materials, make reports, order materials and supplies, retrieve student information, and meet other reporting and communication requirements. ...The Center will facilitate communications between parents and teachers via telephone, modem, speaker, and answering machine. The answering machine will be capable of playing individualized messages to parents when they dial a student's code number.

## Audrey Cohen College for Human Services

The College for Human Services. San Diego and six other sites.

Audrey Cohen
345 Hudson Street
New York, NY 10014
212-989-2002 ext. 215

Students learn best when they can see the connection between what they are learning and the real world, and when they see that what they have learned in school can make a positive change in the community. This premise is the foundation on which The Audrey Cohen College Design Team proposal is built. Each semester, students will study a major Purpose that consists of two components: a substantive body of knowledge and a socially important thrust. Examples of Purposes are, "We Work for Good Health" and "We Use Technology to Meet Human Needs." Core subjects—from mathematics and science to literature, history, geography, and English—will be focused to relate to each semester's Purpose. Technology will be used for information gathering and analysis. Students will spend several hours in organizations outside the classroom each week directly applying what they have learned at

school. "This applied learning, which relates to the semester's Purpose, is the cornerstone of the educational program. ... In every semester, children will learn to choose and use technology for information gathering and analysis. ... Interactive multimedia will be used by students to develop problem-solving abilities. ... Computer systems and networks will have telecommunication capabilities, enabling students and teachers to communicate with other College of Human Service team schools around the country or even around the world."

## Community Learning Centers of Minnesota

Community Learning Centers of Minnesota.

John Cairns
Public Schools Incentives
2400 IDS Center
Minneapolis, MN 55402
612-334-8532

Minnesota offers the opportunity for teachers to accept responsibility for what their students learn and to contract with school boards to begin a school with the understanding that students will meet agreed upon standards for improvement or the school charter will not be renewed. This teacher accountability and flexibility is a unique feature of the Community Learning Centers design proposal. While working within existing budgets and targeting five core subjects, dollars will be reallocated to better meet the needs of students with appropriate curriculum and learning tools. Personal growth and needs, not just classroom needs, are emphasized in this design. ... Each Center will use technology to enhance student learning. Ratios of personnel versus technology may differ radically from those found in public schools. Resources will be reallocated so that more is accomplished with the same dollars. For example, by reconfiguring how teachers are used in the classroom and increasing the use of paraprofessionals, staffing costs could be significantly reduced and that money allocated to equipment instead.

## The Co-NECT School

The Co-NECT School: A Design for the Twenty-First Century Schools. Boston, MA, Worcester, MA.

John Richards
Bolt, Beranek, Newman
10 Moulton
Cambridge, MA 02138
617-873-3031

With a thrust toward a curriculum focused on math and science, the Co-NECT Schools will use existing technologies to bring practical applications of everyday circumstances into the classroom. The Co-NECT concept will demonstrate that technologies can create a communications environment in which much broader, deeper, and stronger learning can occur. Teachers, students, and all school and volunteer personnel will make technology an integral feature in their learning programs. All children will master the five core subjects and become comfortable with technology, while learning self-direction, perseverance, and commitment to quality. ... Access will be universal to a flexible open computer-based communications network that connects all school community members with each other and to a rich array of local, national, and global learning resources and tools. Computers will be utilized in all aspects of learning. School design calls for extensive and pervasive use of computer. multi-media, and interactive video technologies in virtually every activity students undertake. ... Co-NECT schools will be connected to the NSF Internet regional networks.

## Expeditionary Learning

Expeditionary Learning: A Design for New American Schools. Portland, ME; Boston, MA; New York, NY; Decatur, GA; Douglas County, CO.

Diana Lam
Outward Bound USA
384 Fict Point Road
Greenwich, CT 06830
203-661-0797

Beginning with the concept, "To start a school is to proclaim what it means to be a human being," this team believes that children will learn to think by taking them through programmatically related voyages and adventures. The five core subjects are intertwined into all programs and the International Baccalaureate will be the standard by which students will be assessed. With a focus on community service and character development, expeditions will provide students with critical personal and academic opportunities through intellectual and experiential expeditions that will call on intellectual inquiry and rigor, physical stamina, and service ethic.

There is no specific mention of technology in the discussion of this proposal, although TERC is listed as one of the partners, with an indicated responsibility of "science, mathematics, and technology curriculum development."

## Los Angeles Learning Centers

The Los Angeles Learning Centers.

Peggy Funkhouser
Los Angeles Education Partnerships
315 West 9th Street
Suite 1110
Los Angeles, CA 90015
213-622-5237

The faces speak of the diversity of the cultures and ethnicity. More than half of them are poor. For many, English is a second language. They walk in neighborhoods isolated by freeways and marred by violence. But they are eager, energized by possibility and challenge. These are the children of Los Angeles who, through continuity, incentives, modeling, nurturing, and high expectations, can achieve world-class standards of education. This is the vision of the designers of The Los Angeles Learning Centers—five corporate partners, top leadership of the Los Angeles Unified School District and the United Teachers of Los Angeles, and other experts in education. Their plan advocates a "Moving Diamond" of student support that links each young student with an older student, teachers, parents, and a community volunteer throughout grade clusters. Teachers will become continual learners, the classroom will be stretched to include the family, the neighborhood, the workplace, and the city; health and social services will become integrated into the school to support readiness to learn. Technology will link learners, teachers, and parents to the world and each other. ... The Centers will make state-of-the-art instructional technologies available to teachers and students and will integrate systems widely used in business to maximize administrative efficiency. Technologies will link learners, teachers, and parents.

## Modern Red Schoolhouse

The Modern Red Schoolhouse. Columbus, IN; Beech Grove, IN; Charlotte, NC; Greentown, IN; Indianapolis, IN; Kayenta, AZ.

William Bennett
Hudson Institute
Herman Kahn Center
PO Box 26919
Indianapolis, IN 46226
202-223-7770

Believing that all students can achieve high standards, The Modern Red Schoolhouse brings the much-heralded "classical education," time-

tested and proved in certain existing older school designs, to the classroom for all children—rural, urban, suburban, and native American communities. With a strong emphasis on the use of technology, students will master five core subjects and will commit to an Individual Education Contract, thus bringing personal accountability to this "old fashioned" idea about schooling. ... The school will make extensive use of computers, databases, and networks for instruction, management, and communication between home, school, and community. Hudson Schools will apply technology in concert with other elements of the design; technology will not merely be overlaid upon a "business as usual" teaching system. Electronic bulletin boards, community-access TV, and a school-specific database will provide significant vehicles for parents and local businesses to hear from, communicate with, or keep track of their school.

## National Alliance for Restructuring Education

The National Alliance for Restructuring Education. (Schools at 243 sites in seven states are planned to be functioning by 1995.)

Marc Tucker
National Center on Education and the Economy
39 State Street, Suite 500
Rochester, NY 14614
716-546-7620

An output-driven, performance-oriented system of American education that produces students meeting national achievement standards benchmarked to the highest in the world is the goal of The National Alliance for Restructuring Education. This group of nationally recognized education, social policy, management, and technology experts proposes doing this by "breaking the current system, root and branch." The believers include the states of Arkansas, Kentucky, New York, Vermont, and Washington, and the cities of Pittsburgh, Rochester, San Diego, and White Plains, all of which have signed on as participants. The plan starts with the premise that nothing short of a complete reinvention of the present system will do. It calls for defining the outcomes wanted and measuring that progress accurately. Then it calls for enriching curriculum, partly by altering teaching methods and partly by application of technology to the classroom. Health and human services will be integrated with the schools. Organizationally, schools and entire systems will take a lesson from America's best corporations and apply principles of Total Quality Management. Special attention will be paid to coalescing the support of the host communities throughout the reform effort. ... The Apple Classroom of Tomorrow (ACOT) program of Apple Computer, Inc., backed by the full resources of Apple Computer and ACOT's national

network of laboratories and demonstration sites, will be responsible for providing technical assistance needed for fully integrating advanced computer-based technology into the new curriculum.

## Odyssey Project

The Odyssey Project in Gaston County, NC.

Joesph Miller
Gaston County Design Team
943 Osceola Street
PO Box 1397
Gaston, NC 28053
704-866-6202

Students who graduate from Odyssey learning centers will be Communicators, Collaborators, Creative Producers, Critical Thinkers, and Concerned and Confident Citizens. This formal system of basic schooling for ages 3 to 18 will require students to master English, social studies (including geography), science, and mathematics objectives, with an appropriate balance between learning concepts, acquiring information, and applying essential processes. Odyssey students will also study a second language, art, drama, and kinesthetics at each level of schooling. Instead of grade levels, age clusters will be used, with all movement in or out of learning cadres determined by accomplishments of performance outcomes, not age, grade levels, or time frames. Learners will attend school at least 200 days each year. Social and health services will be available on campus. By the time they graduate from an Odyssey center, students will have performed at least 220 hours of quality community service time. All students will leave school technologically literate.

## Roots and Wings

Roots and Wings: Universal Excellence in Elementary Education, Lexington Park, MD.

Robert Slavin
Center for Research on Effective Teaching
John Hopkins University
3505 N. Charles Street
Baltimore, MD 21218
410-516-0274

Roots and Wings seeks to provide every student not only with strong basic skills, but also with the thinking skills, creativity, flexibility, and broad world view to learn. With strong roots in the appropriate

curriculum and support services for all children, students will be prepared to succeed in their early years of schooling, and thus will develop wings to carry them to further successful learning. The design calls on "neverstreaming," as opposed to mainstreaming—based on the concept that children get lost or incorrectly labeled early in their school careers and then must be mainstreamed back into regular classrooms. Neverstreaming suggests that most children will succeed in regular classrooms if given the best early tools in school. ... Computer technology will be used extensively in all Roots and Wings schools, especially in conjunction with WorldLab. Students will have access to CD-ROM encyclopedias and other databases, and they will simulate scientific experiments on the computer.

## Vendor Contacts

There are many vendors (companies) that provide a specific product or service for the education market. The precollege education market spends more than $220 billion annually. Vendors are in the business of getting a piece of this enormous pie.

The TAC needs to know who the computer-oriented vendors are and what they can offer schools. The following is a partial list of vendors who exhibited at the National School Board Association's Sixth Annual Technology and Learning Conference at the INFOMART in Dallas in October, 1992, and/or the MECC Conference in Minneapolis in November, 1992. This alphabetical list is not an endorsement of these vendors. Rather, it is designed to serve as a starting point for the TAC to gather information about educational technology.

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| **Apple Computer, Inc.**<br>Mariana Blvd.<br>Cupertino, CA 95014<br>408-996-1010 | Makers of the largest installed base of computers in education; Apple II and Macintosh computers, Powerbooks, networks, CD drives, etc. |
| **Association for Educational Communications and Technology**<br>1025 Vermont Ave, NW, Suite 820<br>Washington, DC 20005<br>202-347-7834 | Publications and videotapes for educators |
| **Broderbund Software, Inc.**<br>500 Redwood Blvd.<br>Novato, CA 94948-6125<br>800-521-6263 | Produces educational software |

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| **Cable in the Classroom**<br>1900 N. Beauregard, Suite 108<br>Alexandria, VA 22311 | A free service to educators, provides free cable and commercial-free programming to schools |
| **CEL Educational Resources**<br>477 Madison Avenue<br>New York, NY 10022<br>212-421-5000 | The Video Encyclopedia of the 20th Century: 83 hours of footage on 42 videodiscs with indexed reference material and interactive software |
| **Chancery Software Limited**<br>4170 Still Creek Drive, Suite 450<br>Burnaby, BC, Canada VSC 6C6<br>604-294-1233 | Producer of "MacSchool," school administration software |
| **Churchill Media**<br>12210 Nebraska Avenue<br>Los Angeles, CA 90025<br>800-334-7830 | Producer/distributor of curriculum-based videodiscs and films |
| **Cliffs Studyware**<br>8950 LaJolla Village Drive, #2103-A<br>LaJolla, CA 92037<br>619-452-1070<br>408-649-7725 | Course reviews, exam preparation (SAT, ACT, etc.) software by publishers of study notes |
| **Columbia Computing Service**<br>CTB Macmillan/McGraw-Hill<br>2500 Garden Road<br>Monterey, CA 93940 | Integrated educational software, learning systems, and educational products |
| **Computer Chronicles**<br>Box 2954<br>Harrisburg, PA 17105<br>800-366-9484 | Videocassettes or newsletter subscription ($29.50); a weekly Public Broadcast System series documenting current software and hardware |
| **Computer Curriculum Corporation**<br>Simon & Schuster Technology Group<br>1701 W. Euless Blvd., Suite 139<br>Euless, TX 76040<br>800-772-7177 | Produces and sells an integrated learning system for schools using CAI software |

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| **C-Span in the Classroom**<br>400 North Capitol Street, Suite 650<br>Washington, DC 20001 | Program materials to aid educators using C-Span, video coverage of government via satellite |
| **Discis Knowledge Research, Inc.**<br>45 Sheppard Ave East<br>Toronto, ON, Canada M2N 5W9<br>416-250-6537 | Makers of CD-ROM books, including fairy tales, Aesop fables, and other works of literature |
| **Discovery Networks**<br>7700 Wisconsin Avenue<br>Bethesda, MD 20814-3522<br>301-986-0444 | Operates The Discovery Channel, with quality educational documentaries, and The Learning Channel, for lifelong learning |
| **Dukane Corporation**<br>2900 Dukane Drive<br>St. Charles, IL 60174<br>708-584-2300 ext. 502 | The Dukane School Management System combines intercom, telephone, video, computer access, and bell-signaling into a single master computer |
| **Dynacom, Inc.**<br>5005 Lincoln Way East, Suite A<br>Mishawaka, IN 46544<br>219-255-2044 | A multimedia communication system within school buildings |
| **Education Satellite Network**<br>2100 I-70 Drive, SW<br>Columbia, MO 65203<br>314-445-9920 | Clearinghouse of educational programs via satellite |
| **Educational Resources**<br>1550 Executive Drive<br>Elgin, IL 60123<br>708-888-8300 | Nationwide reseller of educational software and technology |
| **Educators OnLine**<br>2011 Crystal Drive<br>Suite 813<br>Arlington, VA 22202<br>703-920-1808 | On-line teacher recruiting and applicant tracking system |

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| **EduQuest**<br>IBM Educational Systems Company<br>P.O. Box 2150<br>Atlanta, GA 30301-2150<br>404-238-3174 | Multimedia products for the IBM, "Teaching and Learning with Computers" concepts, and K-12 classroom offerings |
| **Electronic Learning**<br>411 Lafayette Street<br>New York, NY 10003<br>212-505-4902 | A monthly publication with useful product announcements and articles about technology in education; subscription fee after free introductory issues |
| **Encyclopedia Britannica Educational Corporation**<br>310 South Michigan Avenue<br>Chicago, IL 60604<br>312-347-7947 | Source for the Compton's Multimedia Encyclopedia (a CD-ROM-based reference tool), FOSS science courseware, and Diez Temas, a multimedia Spanish-language course |
| **Houghton Mifflin Company**<br>1900 South Batavia Ave.<br>Geneva, IL 60134 | Publishes textbooks and supplementary materials |
| **Intellimation**<br>P.O. Box 1922<br>Santa Barbara, CA 93116-1922 | Distributor of educational software |
| **Interactive Communication System, Inc.**<br>8050 N. Port Washington Road<br>Milwaukee, WI 53217<br>414-352-4404 | Producer of Discourse, a real-time classroom system that allows immediate student responses |
| **International Society for Technology in Education (ISTE)**<br>1787 Agate Street<br>Eugene, OR 97403-1923<br>503-346-4414 | Professional organization that publishes information and resources for technology-related learning, teaching, and educational materials |
| **Jostens Learning Corporation**<br>1553 48th Street<br>Sacramento, CA 95819-4417<br>800-521-8538 ext. 6443 | Produces and sells an integrated learning system in schools using CAI and interactive software |

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| **Learning Services**<br>P.O. Box 10636<br>1203 Willamette St.<br>Eugene, OR 97401<br>800-877-9378 | Nationwide reseller of educational software and technology; Learning Services Academy—national seminars on topics pertinent to educators |
| **Macmillan New Media**<br>124 Mt. Audburn Street<br>Cambridge, MA 02138<br>617-661-2955 ext. 37 | Multimedia software for education and career planning on CD-ROM |
| **Major Educational Resources**<br>10153 York Road, Suite 107<br>Hunt Valley, MD 21030<br>301-628-0915 | Producers of DIGICARD Network, a multiplatform (Apple, IBM, Macintosh) system |
| **Microsoft Corporation**<br>16011 NE 36th Way<br>Box 97017<br>Redmond, WA 98052-6399<br>206-936-3055 | Producers of major software products available in academic versions at educator discount prices |
| **National Association of Regional Media Centers**<br>c/o BCIU<br>705 Shady Retreat Road<br>Doylestown, PA 18901<br>215-348-2940 ext. 1600 | Goals promote leadership among members to enhance equitable access to media, technology, and information services to educational communities |
| **National Distance Learning Center**<br>University of Kentucky/OCC<br>4800 New Hartford Road<br>Owensboro, KY 42303<br>502-686-4556 | A publicly funded clearinghouse for distance education curriculum information offered free of charge to educators |
| **National Education Association**<br>National Foundation for Improvement in Education<br>1201 16th Street, NW<br>Washington, DC 20036<br>202-822-7747 | NFIE programs support teachers in carrying out innovative research and special projects |

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| **National Geographic Society**<br>17th & M Streets, NW<br>Washington, DC 20036<br>202-857-7337 | The National Geographic Kids Network provides students with hands-on learning activities for geography and telecommunications |
| **National School Board Association**<br>1680 Duke Street<br>Alexandria, VA 22314<br>703-838-6778 | Coordinates the Technology Leadership Network; publishes widely on technology issues in education |
| **Peter Li Education Group**<br>2451 East River Road<br>Dayton, OH 45439<br>513-294-5785 | Publishes *Technology and Learning*, a magazine covering the latest trends, products, and issues related to technology in schools; free introductory issues |
| **Pioneer Communications of America, Inc.**<br>600 E. Crescent Ave.<br>Upper Saddle River, NJ 07458<br>201-327-6400 ext. 146 | Supplier of multimedia equipment. Products include laserdisc players, barcode technology, CD-ROM drives |
| **PBS/Elementary/Secondary Service**<br>1320 Braddock Place<br>Alexandria, VA 22314-1698<br>703-739-5127 | High-quality video programs for educational uses of television in schools |
| **Radio Shack Education Division**<br>1600 One Tandy Center<br>Ft. Worth, TX 76148<br>817-390-3091 | Major supplier of computers, networks, and multimedia equipment |
| **Roger Wagner Publishing**<br>1050 Pioneer Way, Suite P<br>El Cajon, CA 92020 | Produces *Hyperstudio* software for Apple IIgs and Macintosh |
| **Satellite Educational Resources Consortium (SERC)**<br>P.O. Box 50008<br>Columbia, SC 29250<br>803-252-2782 | Interactive distance education for high school and middle school students; upcoming partnership with PBS to offer more choices |

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| **Satellite Scholar**<br>2347 South Avenue West<br>Missoula, MT 59801<br>406-721-3662 | A national comprehensive guide to educational programming on satellite (subscription fee) |
| **Silver Burdett & Ginn**<br>250 James Street<br>Morristown, NJ 07960 | Publishes textbooks, teaching aids, and supplementary materials for software and technology |
| **South-Western Publishing Company**<br>5101 Madison Road<br>Cincinnati, OH 45227<br>513-527-6976 | Publishes textbooks, teaching aids, and supplementary materials for software and technology |
| **Tom Synder Productions**<br>80 Coolidge Hill Road<br>Watertown, MA 02172<br>1-800-342-0236 | Produces educational software and publications about using technology in schools |
| **T.H.E. Journal**<br>El Camino Real, Suite 112<br>Tustan, CA 92680<br>714-730-4011 | A monthly magazine covering the latest trends, products, and issues related to technology in schools; free introductory issues |
| **The Learning Company**<br>6493 Kaiser Drive<br>Fremont, CA 94555<br>510-792-2101 | Produces educational software |
| **The Mecklenburger Group**<br>203 Yoakum Parkway, #725<br>Alexandria, VA 22304<br>703-823-6853 | Publishes the newsletter *Inventing Tomorrow's Schools* (subscription fee) |
| **Ventura Educational Systems**<br>910 Ramona Street, Suite E<br>Grover Beach, CA 93433<br>800-336-1022 | Produces a wide variety of educational software |

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| **Videodiscovery**<br>1700 Westlake Ave, North, Suite 600<br>Seattle, WA 98109 | Produces a wide variety of educational videodiscs and multimedia products |
| **Whittle Communications**<br>333 Main Street<br>Knoxville, TN 37902<br>615-595-5506 | Produces Whittle Educational Network, a cost-free educational program, with commercials, via satellite |
| **Wings for Learning/ Sunburst**<br>P.O. Box 660002<br>1600 Green Hills Road<br>Scotts Valley, CA 95067-0002<br>800-321-7511 | Educational software, videotapes, videodiscs, and print materials |
| **WordPerfect Corporation**<br>1555 North Technology Way<br>Orem, UT 84057<br>801-222-4050 | Producers of major software products available in academic versions at educator discount prices |

# Appendix 4
# Recommended Readings

The success of a TAC depends heavily on its members developing a shared vision and understanding of the major issues the council is addressing. Education is a large and complex field. Computer technology is a rapidly changing and complex field. Thus, members of the TAC will need to devote substantial effort to learning about education and potential roles of technology in education.

As might be expected, there are innumerable books relevant to the field of computer technology in education. This appendix gives a briefly annotated list of some of the classics and some of the more recent ones. The list provided here can be considered as a representative sample of the literature. Probably each member of the TAC will be able to suggest one or more additional books that would make a good addition to the list.

The books listed in this appendix have been divided into three categories: Information Age, School Restructuring, and Computers in Education. We have also included two recent periodicals that were entirely devoted to assessment.

There is no expectation that each member of a TAC will read all of these books. However, collectively it is important that the TAC understand the underlying ideas discussed in these books. Thus, it may prove helpful for a TAC to build a library of these and similar references. The library can be used by the TAC and by others who are interested in the field of technology in education.

## The Information Age

Evans, C. (1979). *The micro millennium.* New York: The Viking Press.

*The Micro Millennium* is a classic for a person wanting to develop an understanding of the Information Age. It is an analysis of the immediate past, present, and possible future of today's civilization. The emphasis is on computer technology, especially information processing and telecommunications. The book deals with the role and impact of computers in the modern world.

The book is particularly interesting because the "future" that Evans writes about is now our immediate past. Thus, we can gain insight into attempts to predict the future of technology and its impact on the world.

Readers of this book are likely to be impressed by Evans' insights into how computer technology is affecting and will affect our society.

Naisbitt, J. (1982). *Megatrends. The new directions transforming our lives.* New York: Warner Books, Inc.

Naisbitt, J., & Aburdene, P. (1990). *Megatrends 2000: Ten new directions for the 1990s.* New York: Warner Books, Inc.

These are "popular" as opposed to "academic" works. In them, Naisbitt portrays an optimistic view of the future.

The first of these books is now a classic and is reported to have sold more than 8 million copies. It has three major features of potential interest to TAC members. First, Naisbitt does not write about a distant and utopian new age; he is concern with the time between eras, a time in which we are leaving the past and entering the future, a time of change and questioning; a time when we can have extraordinary leverage, influence, and responsibility. Second, "the book is a synthesis in the age of analysis"; there is no doubt that social ingredients blend in a complicated and intricate way, but Naisbitt has managed to sift through a huge amount of current literature and develop an easily readable account of the 10 major trends forming the new era. Finally, computer-related technology is highlighted. For Naisbitt, it is clear that the emerging era is appropriately called the Information Age.

*Megatrends 2000* can be considered as a sequel to the first megatrends book. It continues the optimistic view of the future and discusses a variety of newly emerging trends. There is considerable emphasis on world trade (of relevance to educators, since our students are competing in a global job market), the rapidly increasing number of women in leadership positions, and the rapid growth and potential of genetic engineering.

Toffler, A. (1980). *The third wave.* New York: Bantam Books.

The first two waves were the agricultural and the industrial socioeconomic revolutions. The third is our current socioeconomic revolution based on electronic technology. Toffler provides a clear view of the complexity and diversity of forces working together to form the new world civilization. This is the second book of a trilogy. The third is listed below.

Toffler, A. (1990). *Powershift: Knowledge, wealth, and violence at the edge of the 21st century*. New York: Bantam Books.

This book is the culmination of a trilogy and represents 25 years of Toffler's efforts. Like *The Third Wave*, the book is a extensively documented study about the complexity and variety of factors involved in shaping tomorrow's civilization.

Toffler includes an extensive analysis of computers and their roles (from manufacturers to hackers) in forming the new civilization. However, the emphasis of the study is on a sociology of power, especially in terms of business, economics, and finance, certainly a most important force driving the future of our society. From this point of view, the book could be said to be an expansion and upgrading of Toffler's prior work about change, but this time the center of attention is on changes in which people or groups of people have power. In education, the movement toward site-based councils and site-based management is a movement of power.

## Educational Reform

Conley T. D. (1991). *Restructuring schools: Educators adapt to a changing world*. Eugene, OR: ERIC Clearinghouse on Educational Management.

This publication is a concise discussion of the school restructuring movement. Based on abundant research, Conley presents a broad view of the definition, reasons, scope, actors, and elements of the increasing drive toward reshaping the public education system. The book gives a complete view of the complex, multidimensional, and at times contradictory nature of the many current efforts to redefine the goals and priorities of education. At the same time, it offers a helpful array of patterns, problems, concepts, and practices of many people and organizations involved in reshaping the purpose and nature of the teaching/learning process in schools.

Fullan, M.G. (1991). *The new meaning of educational change*. New York: Teachers College Press.

This book is a structured, simple explanation of theory of change applied to the educational process. Fullan argues that for change to occur we need to understand what changes to implement (theories of education) and how to implement these changes (theory of change). Step by step, these two closely connected dimensions smoothly and progressively unfold, moving readers from clearly grasping the meaning of change to strongly desiring to take action and produce results.

Fullan succeeds in communicating his message because he painstakingly dissects the whole anatomy of educational innovation: change definition, purpose, factors, actors, scope, planning, initiation, implementation, continuation, conditions, requirements, and levels. Despite the scholarly and academic display of numerous references and quotations, the 350 pages are readable and pleasant. For those who want to understand and produce educational change, and cherish the idea of equality of opportunity and achievement (the cognitive/academic and the personal/social faces of educational change), this book can be truly enlightening.

Fiske, E. B. (1991). *Smart schools, smart kids: Why do some schools work?* New York: Simon & Schuster.

A great deal has been written about the failings of American schools. In *Smart Schools, Smart Kids,* Edward Fiske and his associates Sally Reed and R. Craig Sautter focus mainly on what works—the emphasis is on the positive rather than the negative. The book is a collection of case studies of educational reforms that are working and/or show good promise of working. Some of the cases focus on individual children and how a restructured school has made a major difference in their lives. Other cases focus on teachers and how restructuring has empowered them. Still other cases focus on school administrators, parents, and some of the leading figures in the school reform movement.

This is not a book about computer-related technology in education, although there is a major chapter on this topic. It is not a book about quick and easy solutions. Rather, the emphasis is on how difficult the problems are—and that there are quite a few cases where significant progress is occurring. The overall message in the book is that educational research and experience has produced a wide range of educational reforms that work. Relatively few school sites have attempted to combine a number of these types of changes. The authors contend that if a number of the school reform ideas are combined, it will lead to major improvements in our educational system.

Gardner, H. (1991). *The unschooled mind: How children think and how schools should teach.* Basic Books.

Howard Gardner is a professor at the Harvard Graduate School of Education, a researcher at the Boston Veterans Administrative Medical Center, and was a MacArthur scholar. He is well known for his work as a cognitive scientist, educator, and prolific writer.

This book summarizes ideas from a number of Gardner's books, including *Frames of Mind* and *The Mind's New Science*. The book begins with a historical background on theories of intelligence and of learning, culminating in the current cognitive science and information-processing models. Building on this background, the book then focuses on developing a useful theory of how students learn and, consequently, how schools should teach. Gardner grounds his arguments in case studies and basic research. He argues that education must move beyond rote memory, and instead place major emphasis on problem solving and higher-order cognitive skills. He feels that schools need to incorporate ideas typically found in "hands-on" science-and-technology museums and apprenticeship systems. He feels that schools need to de-emphasize paper-and-pencil tests and place more emphasis on authentic assessment.

Sarason, S. B. (1990). *The predictable failure of educational reform. Can we change course before it's too late?* San Francisco: Jossey-Bass Publishers.

Educational reform has been a major activity in the last decade, and it seems that is going to be so for many years to come. Educators appear to have known for a long time what they need to do, and they have devoted an enormous amount of energy to overcoming the weaknesses of the educational system. However, their efforts have not flourished, and educational reform, one could say, has failed. Why? After describing the educational system and the different conceptions (internal and external) of it, Sarason deals with the conditions, factors, and reasons for educational reform.

A key component of the book is an analysis of who has the power in our educational system. He argues that school reform movements in the past have failed because there was no change in who was empowered. Sarason argues that students and teachers must be empowered if education is to be improved. With regard to conditions, he advocates a proper and responsible participation of teachers and students in the decision-making process.

Sarason has spent his long and productive professional career in efforts to improve education for all children. Many of his ideas are unconventional and challenging. This book is "must" reading for TAC members.

U.S. Department of Education. (1991). *America 2000, an education strategy.* Washington, DC: Author.

This booklet presents the 1988-1992 (George Bush) Federal Administration proposal to improve the quality of education. The proposal is presented in the form of six goals, four strategies (tracks), and some questions with their answers. The booklet includes both a vision of and the basic elements for a long-range plan concerning schools and schooling. The focus is on creating an educational system in the United States that is second to none in the world, and that is first in science and mathematics. The booklet makes only brief mention of technology as a component of education or as an aid to instruction.

## Educational Computing

Kearsley, G., Hunter, B., & Furlong, M. (1992). *We teach with technology: New visions for education.* Wilsonville, OR: Franklin, Beedle and Associates, Inc.

The most important characteristic of this text is that it focuses exclusively on the classroom and on the specific lesson content that makes up the basic unit of the teaching-learning process. Topics covered in the book include teacher productivity, computer writing, school newspaper publishing, open door to the world, doing real science, cross-cultural connections, and electronic music. These are all concrete and practical applications of computer technology to the classroom setting. The book is written for teachers, but it also provides a solid background and broad perspective on which policymakers working in the area of educational computing can base their plans, budgets, and procedural guidelines.

Lockard, J., Abrams, P. D., & Many, W. A. (1990). *Microcomputers for educators.* Glenview, IL: Scott, Foresman/Little, Brown Higher Education.

This book is designed to be an aid for training teachers. It deals in a thorough, clear, and very structured way with the major conventional issues related to using computers in schools. Major topics covered include the emergence and history of computer systems, the computer as a tool, computer-assisted instruction, courseware evaluation, computer programming in the school curriculum, computer literacy, and implications of computer use. In addition, this textbook contains an extensive list of informational resources. These include literature references; software, software producers, and providers; CD-ROMs; videodisc and related product referrals; publications and journals of interest for educators; and a list of major professional associations and

organizations that can be a valuable resource for policymakers seeking information on training programs, research projects, and counseling.

Miller, S. K. (1987). *Selecting and implementing educational software.* Boston, MA: Allyn and Bacon Inc.

This book approaches computers in education from the software point of view. Miller offers a relatively complete framework for consideration of a wide range of the types of software that students use in the classroom. From this point of view, this book can be a valuable resource for choosing instructional material. The book includes reviews, readings, and references, lists producers, describes evaluation procedures, and, what is most important, suggests a way of organizing the computer learning environment in terms of educational software.

Moursund, D., & Ricketts, D. (1988). *Long-range planning for computers in schools.* Eugene, OR: Information Age Education. (Available from ISTE.)

This book provides an introduction to the field of computers in education and to long-range planning. Using problem solving as a unifying theme, it addresses long-range planning for computers in schools. The book is written for planners and for decision makers—the type of people who agree to serve on a TAC.

The book's long-range planning component begins with a discussion of goals of education and continues with an analysis of some of the overall goals for computer technology in education. The authors argue that the goals for computers in education are consistent with and supportive of the goals of education.

There is a detailed discussion of the long-range planning process and some of its difficulties. A number of strongly recommended goals for computers in education are listed and discussed. These are tied to the general goals for computers in education and goals of education. Additional potential computer-related goals are discussed in less detail.

This book is concrete and insightful; it deals with specific issues, offers practical applications, and presents workable proposals. This book should prove very useful to members of the TAC.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas.* New York: Basic Books. (Available from ISTE.)

Papert is well known for his work as a computer scientist at the Massachusetts Institute of Technology. He is still better known for his work as a computer educator, particularly in the Logo field. *Mindstorms* presents a philosophy of education that is built on and extends the work of Piaget. The focus is on hands-on, discovery-based learning by doing, while taking advantage of Logo and similar powerful new learning environments. While the book places considerable emphasis on the learning of mathematics, the philosophy of computer use that Papert supports can be extended to all of education.

Taylor, R. P. (Ed.). (1980). *The computer in the school: Tutor, tool, tutee.* New York: Teacher College Press.

This book is a classic, providing an excellent overview of the early development of the field of instructional uses of computers. It is a collection of writings by five of the most influential pioneers of computer use in schools: A. Bork, T. Dwyer, A. Luehrmann, S. Papert, and P. Suppes. These five pioneers approach the field of educational computing both from a solid conceptual framework and from a productive practical stand. All of them are scientists, computer experts, and educators. Their articles focus on the "premicrocomputer" era of educational computing.

Taylor analyzes the field of computers in education from the point of view of the computer as a tutor (computer-assisted instruction), the computer as a tool, and the computer as a tutee (people write programs that "teach" the computer how to perform tasks.) This model has held up well in the decade and more since Taylor's book was originally published. During that time period, microcomputers have become commonplace. However, many of the underlying ideas developed before 1980 are independent of the type of computer being used to implement the ideas.

Thornburg, D. D. (1991). *Education, technology, and paradigms of change for 21st century.* Starsong Publications. (Available from ISTE.)

Thornburg's short book is a provocative account of the ongoing process of coupling two major themes—pedagogical thought and technological development—in a combination that has no parallel in history. Thornburg argues that computers and pedagogical studies can converge and transform schools for the benefit of all children. He envisions school as a place where music, history, mathematics, physics, and games comfortably interact as an integrated whole; where students

become constructors of knowledge, long-life learners, lovers of discovery, explorers of ideas, and inventors of their own future; and where teachers are increasingly less information deliverers and more knowledge facilitators, less coaches and more cheerleaders for their pupils.

Thornburg presents his concepts more as a flow of insights than as a finished structure of conclusive statements. With a defiant, sometimes irreverent, style sprinkled with examples from daily life, he succeeds in conveying genuine current educational concerns and in progressively building up a visionary paradigm of what education can be in 21st century. The book includes a glossary of 270 technical terms.

## Assessment

The purpose of integrating technology into school and restructuring instructional systems is to improve the quality education our children receive. But how do we know that education has improved?

Assessment of student achievement seems like a simple task. Make up a test, have the students take the test, and look at their scores. However, it turns out that it is very difficult to make a test that adequately measures what a student has learned. Moreover, it is even more difficult to make up a test that can be used throughout the country (or, internationally) and that is not biased for or against particular groups of students. If fact, this is so difficult that the assessment instruments developed by the professional testing services are continually under attack. This is despite the fact that a company may spend hundreds of thousands of dollars developing and testing a single assessment instrument.

Assessment is very important because, to a very large extent, the curriculum and teaching are designed to prepare students for the tests. That is, testing drives the curriculum, rather than vice versa. The "rewards" for scoring high on a particular test (for example, a college entrance test) are so high that the goal becomes scoring high on the test rather than learning.

In recent years a number of educators have begun to argue that the objective tests that are so widely used for assessment are inappropriate. They argue that performance assessment is more appropriate. The general argument is that education should focus on preparing students to perform (especially on real-world tasks)—not just to score high on tests. Two major journals have recently devoted entire issues to discussions of performance assessment. A number of school districts and entire states are now mandating use of performance assessment.

*Educational Leadership*, 1992, Volume 49, No. 8

*Applied Measurement in Education*, 1992, Volume 4, No. 4

These two journals provide an in-depth analysis of the nature, practices, and concerns about performance assessment. Both journals have articles that not only discuss the difference between the new and traditional approaches to student assessment, but they also define performance, authentic, and portfolio assessment. The two journals list a variety of the alternative practices in learning evaluation applied to different specific subject matters within a curriculum context. Many of the research articles in these journals praise and welcome the new practices, but at the same time they warn and admonish against accepting them without question. While performance assessment is increasingly endorsed and accepted, there is not yet adequate research to verify that these promising practices actually promote improved quality in education.

The message seems clear. Schools should be exploring the use of performance assessment. However, this is a relatively new endeavor that is fraught with difficulties.

# Appendix 5
# Video Resources

There is a large and rapidly growing video library focusing on computer uses in business, industry, government, and education. The history of the development of the computer industry and computer applications has been well documented.

There are a number of videos of potential value to a TAC. Many are purely commercial in nature—they were produced to help sell particular products or to build the image of a particular company. Such videos may be available free or at very low cost. These videos show how particular products are being used with students. Many include demonstrations with students or case studies of actual schools.

The majority of the videos listed here come from software and hardware companies. More videos are available than are listed here. Contact specific companies or educational organizations on what other videos they might have to offer.

## Technology—Past, Present, and Future

**Chapter One (Source: Apple Computer, Inc., 12 minutes)**

Dramatization of futuristic computer use. Includes uses with physically and mentally handicapped students.

**Knowledge Navigator (Source: Apple Computer, Inc., 5 minutes)**

This is a classic. Short dramatization of futuristic computer use. The dramatization is followed by a discussion of current and future technology.

**The Machine That Changed the World, ACM Videos (Source: PBS, a series of five hour-long shows)**

This series is an excellent view of the history of computers. The videos include present-day uses of technology and future considerations.

**The Computer Chronicles (Source: PBS, a weekly TV program)**

This weekly program focuses on new software and technology in the computer field. A typical program consists of Macintosh and PC software reviews, as well as brief presentations of new technology by experts and authors from leading computer magazines.

## Technology and Schools

**Jostens Learning Systems (Source: Jostens, Inc., 15 minutes)**

Shows the use of the integrated learning system sold by Jostens. Gives a picture of the structure of computer-assisted learning.

**MECC Management System (Source: MECC, 4-5 minutes)**

Uses a management system for evaluating student progress. Deals only with management rather than a total integrated learning system.

**Teaching, Learning, and Technology: A Planning Guide (Source: Apple Computer, Inc.)**

Provides a videodisc showing how computers are used, a CD-ROM with interviews and planning software, and a guide and forms for planning for technology in the schools.

**Vision: TEST—New Models of Instruction (Source: ISTE, 35 minutes/6 segments)**

The Vision: TEST (Technologically Enriched Schools of Tomorrow) videos were produced by the International Society for Technology in Education. The six segments on the first of these three videos are visits to schools where technology has made a difference to students and school structure. The videos show students using computers for a variety of purposes.

**Vision: TEST—For All Our Children (Source: ISTE, 35 minutes)**

Looks at how different technologies can be integrated into the classroom. The emphasis is on equality of access and on routine, widespread use.

**Vision: TEST—The New Media Center (Source: ISTE, 20 minutes segments)**

Looks at using technology to access and use information in the school environment.

## Technology and the Classroom

**Databases in the Classroom (Source: Sunburst, 15 minutes)**

Shows use of a database with students. Uses both student-created databases and purchased databases.

**Geometric Supposer (Judah Schwartz) (Source: Sunburst, 30 minutes)**

Explores the use of *Geometric Supposer* to learn about math concepts.

**HyperCard 1992 (Source: Apple Computer,Inc., 8 minutes)**

Demonstrates multimedia but does not focus on educational aspects.

**Learning (Source: Apple Computer, Inc., 15 minutes)**

Short segments demonstrating computer use for both learning and management tasks. This is also included on the videodisc of the Apple Planning Guide.

**Safari Search I and II (Source: Sunburst, 15 and 30 minutes, respectively)**

Shows techniques for using the *Safari Search* program for teaching problem-solving strategies. Students are seen learning the strategies.

**Second Voyage of the Mimi (Source: Sunburst, 45 minutes)**

Shows the components of the cross-curriculum program *Second Voyage of the Mimi*. The components include video sequences, software, and teacher materials. Also shows use with students.

**Teaching the Factory (Source: Sunburst, 50 minutes)**

Shows use of the *Factory*. Emphasizes use of models to solve problems.

**Ulysses (Source: IBM, 30 minutes)**

Powerful demonstration of multimedia in an educational context.

# Glossary of Key Concepts

The Glossary of Key Concepts can be thought of as a brief summary of the book, organized in alphabetical order. Members of the TAC will find that the key concepts come up repeatedly as they discuss appropriate roles of computers in education.

In these definitions, terms in italiacs refer to other terms in the glossary.

**Advisory Council:** A council made up of a broad range of people (*stakeholders*) who will be affected by the recommendations that the council will make, and who will help to implement the recommendations. An advisory council is an important part of a *site-based management* structure. Typically, such a council serves in an advisory capacity to an organization that has the authority and resources to help impelement recommendations made by the council.

**Alternative assessment** refers to a variety of non-objective forms of *assessment*; it mainly includes *performance assessment*, *authentic assessment*, and *portfolio assessment*. In general, it is a type of assessment opposed to the traditional *objective assessment*.

**Artificial intelligence (AI):** This is sometimes called machine intelligence. It is the study of developing computer systems to perform functions that would be considered intelligent if performed by people. An artificially intelligent computer system can do medical diagnoses, play chess, suggest likely places to mine for minerals, and assist a worker in carrying out complex tasks. From an educational point of view, AI raises the issue of what should we have students learn to do "by hand" and what we should have students learn how to do when assisted by a computer. Currently, much effort is devoted to teaching students to do things computers can already do quite well. See also: expert system.

**Assessment:** To a very large extent, assessment drives the curriculum. That is, many schools "teach to the test." Thus, any efforts to change education must give careful consideration to changing assessment. There are two major purposes for assessment. One purpose is to gather data that students and teachers need in order to improve the learning and teaching activities that are going on. The other is to provide data to other people, such as parents, employers, and taxpayers, who are interested in how well individual students and teachers are doing or how well the overall educational system is doing. In recent years, many people have questioned our heavy

reliance on paper-and-pencil tests—especially objective tests. Now, many school systems are placing increased emphasis on *performance assessment*. See also: alternative assessment, authentic assessment, objective assessment, performance assessment, and portfolio assessment.

**Authentic assessment:** A type of performance assessment that requires that the evaluating activities be carried out in a setting as close as possible to the real world—the world in which the knowledge and skills being taught might eventually be used. Students can be ask to do and produce specific behaviors that are to be evaluated, but these behaviors are to be performed in a simulated or real-world environment. For educational computing, performance and authentic assessment are of paramount importance. If students use computers in their learning process, they must be allowed to use them in a testing context. See also: assessment, alternative assessment, objective assessment, performance assessment, and portfolio assessment.

**Block scheduling:** Many schools base their time schedule on periods of a fixed length, such as 50-minute periods. At the secondary school level, students may move to a different classroom and be with a different group of students each period. This makes it difficult for students to engage in multidisciplinary, cooperative projects. It makes it difficult for teachers to do *team teaching*. Thus, many schools now divide the school day into longer blocks of time, and often the time schedule varies from day to day. This is called block scheduling.

**Computer and information science:** The academic field that focuses on the theory and applications of computers. Computer and information science is now a large and important field of study and research. Some components of computer and information science can be integrated into curriculum at any grade level, and many schools now offer courses in computer programming and computer science.

**Computer-integrated instruction (CII):** The use of a computer as an application tool in the various academic disciplines. The emphasis is upon learning to use the computer application packages and integrating them as everyday tools into a student's overall knowledge. Examples of CII software include database, graphics, spreadsheet, telecommunications, and word processing. Such tools are routinely used by many people on the job, and there is a strong movement to have all students learn to use these computer tools.

**Computer-assisted instruction (CAI):** See computer-assisted learning.

**Computer-assisted learning (CAL):** The use of computers as an aid to learning; sometimes called computer-assisted instruction (CAI). The focus is on learning, learning to learn, being responsible for one's

own learning, and being a lifelong learner. CAL software includes drill and practice, simulations, tutorials, and microworlds. Large-scale CAL systems include record keeping, diagnostic testing, and prescriptive guides as to what to study and in what order. These are often called integrated learning systems.

**Computer:** A machine designed for the input, storage, manipulation, and output of information. Originally, computers were designed to work just with numbers—that is, with numerical information. Today's computers are designed to work with numbers, words, sound, graphics, and video. They are a versatile aid to communication and to problem solving. In this book we use the term computer to refer to a computer system that includes *hypermedia* capabilities.

**Constructivism:** The concept that learners construct their own knowledge. This idea was developed by Jean Piaget. It is part of the underlying theory of hands-on, discovery-based education. Many educators argue that computer-based learning environments are very supportive of constructivism.

**Cooperative learning:** Students working and learning in pairs or small groups. Each student actively contributes to the learning process. This type of instruction lends itself to developing communication, cooperation, problem solving, and other skills that are used outside the classroom. Computer technology can play an important role as students work cooperatively on large, interdisciplinary, multimedia projects. With appropriate use of telecommunications, members of a team may be located in different schools and even in different countries.

**Cross-level tutoring:** The assistance and/or teaching of information from one level of students to a different level of students. Many students learn best by "doing" and by receiving one-on-one help when they run into trouble. Use of cross-level tutoring provides many students with the opportunity to help others learn. This helps both the students doing the tutoring and those being tutored.

**Expert system:** A computer program that attempts to capture some of the human expert knowledge needed to solve a certain type of problem. Thousands of these types of programs are now routinely used in business, industry, and research. See also: artificial intelligence.

**Hypermedia:** A computer can be used as the "glue" connecting *multimedia*. When this is done, the media can be used in an interactive, nonlinear manner and can include the use of a full range of computer capabilities. This is called hypermedia. Many schools now want all of their students to learn to create hypermedia and to use hypermedia as an aid to learning.

**Integrated learning system:** See computer-assisted learning.

**Learning theory:** There are many different theories that help explain how students learn and how to help them learn. Some of these learning theory ideas are incorporated in *computer-assisted learning* (CAL) materials. Progress in developing better learning theories leads to improvements in CAL.

**Mission statement:** A statement that gives the overarching and unifying purpose of an organization. Both an educational system and the TAC need to have mission statements.

**Multimedia:** There are many different types of media, such as slides, movies, audio tape, video tape, CD-ROMs, and laser discs, that can be used to store and present information. Any use of a combination of two or more media is called multimedia. See also: hypermedia.

**Objective assessment:** The use of true/false, multiple-choice, matching, and other "single, right answer" pencil-and-paper modes of assessment. See also: assessment, alternative assessment, authentic assessment, performance assessment, and portfolio assessment.

**Performance assessment**: A learning evaluation approach that includes the following major elements: (a) It is the behavior itself (doing, producing, creating, performing) that is assessed, not just the right answers in a test; (b) assessment activities are themselves significant, formative, and instructional; (c) processes, including cognitive processes, as well as products, are evaluated; (d) assessment activities are placed as close as possible to a real-world setting; and (e) evaluation criteria and standards are in the public domain and known in advance. See also: assessment, alternative assessment, authentic assessment, objective assessment, and portfolio assessment.

**Portfolio assessment:** A method or technique of performance assessment in which the learning evaluation is made by means of purposefully collecting students products and records on their performance progress and achievement over a period of time. If the portfolio is in a *multimedia* or *hypermedia* format, it is called an electronic portfolio. See also: assessment, alternative assessment, authentic assessment, objective assessment, and performance assessment.

**Portfolio:** A collection of student work that is representative of what the student has learned throughout a given time period. The work can show what progress the student has made, or it can be a collection of the best work the student has completed. It reflects competence in authentic on-the-job tasks. Some parts of the portfolio may be in a hypermedia format; this is sometimes called an electronic portfolio.

**Procedure:** A step-by-step set of directions that can be carried out by a computer and that is designed to solve or help solve some category of problems. At the current time, our children spend a lot of time in school learning how to do "by-hand" procedures that computers can do. In effect, children are learning to compete with machines. An alternative is to place more effort on having children learn to work with the machines—to build on the idea of people and machines working together. One of the goals in having students learn about computers is to have them learn procedural thinking—thinking that takes into consideration the capabilities of a computer.

**Site-based management:** A management structure in which the authority to make decisions is given to the people who have to implement the decisions and the people who are affected by the decisions. In recent years this approach to management has proven quite effective in industrial manufacturing. Many schools are now developing site-based management.

**Stakeholders:** In the context of this book, the stakeholders are people who are interested in education, who are affected by the decisions that are made, and who are involved in implementing the decisions. Stakeholders include parents, students, teachers, and business people.

**Strategic Planning:** A process that produces a long-range plan that provides the foundations for strategic decisions for implementing the plan. Implementation of the plan over five or six years should produce a significant change in a system or organization.

**Teacher productivity:** The amount of work a teacher is able to accomplish on any given day or week. The effort a teacher makes in lesson preparation, implementation, and evaluation will vary among individuals. Technology has the potential of making teachers more efficient in their efforts and thus more "productive."

**Team teaching:** In many schools, teachers are organized into teams. Many types of teams are possible. A team of two teachers might handle 60 students in a two-hour math-science class. A team of five teachers might have full responsibility for the education of 140 middle school students for the entire three years the students are in middle school.

**Technology coordinator:** A specialist who interacts with classroom teachers, curriculum specialists, and school administrators to coordinate the instructional use of computers. Many school systems have found that they need technology coordinators both at the individual school building level and for the entire school district.

**Transfer of learning:** One major goal in education is that students be able to apply their increasing knowledge whenever and wherever it is appropriate to do so. Research indicates that if teachers teach for transfer of learning, more transfer will occur. Traditionally, educators have talked about near transfer and far transfer. A more modern theory talks about low-road transfer and high-road transfer. In low-road transfer, the emphasis is on automaticity, somewhat like in a stimulus-response situation. In high-road transfer, the emphasis is on mindful, carefully reasoned application of one's higher-order knowledge and skills to new situations. This requires that the student must: (a) learn the higher-order skill to mastery, (b) understand that the higher-order skill can generalize to other domains, (c) be able to decontextualize the higher-order thinking from the learning situation, and (d) be able to recognize the deep similarities between the learning and transfer situations.

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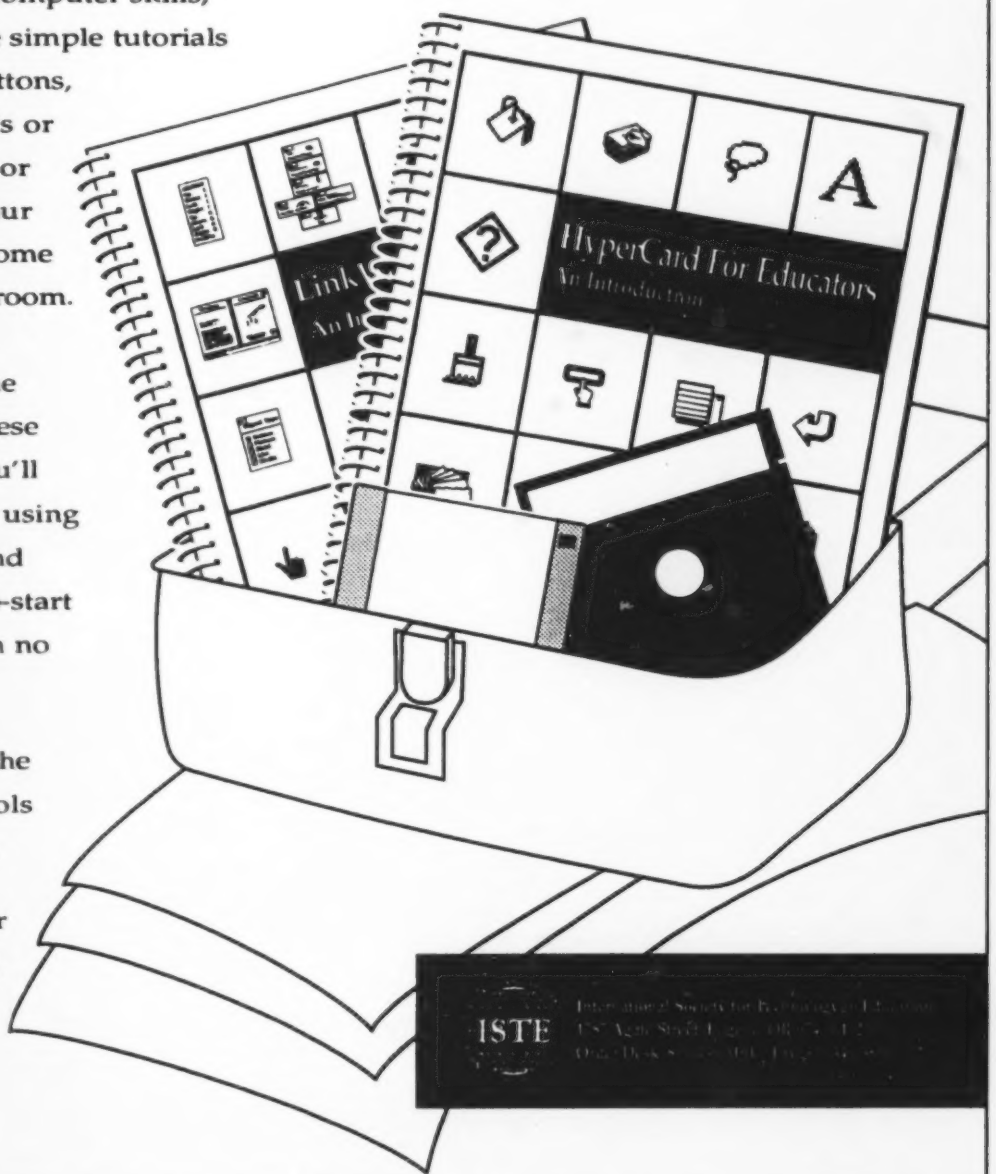

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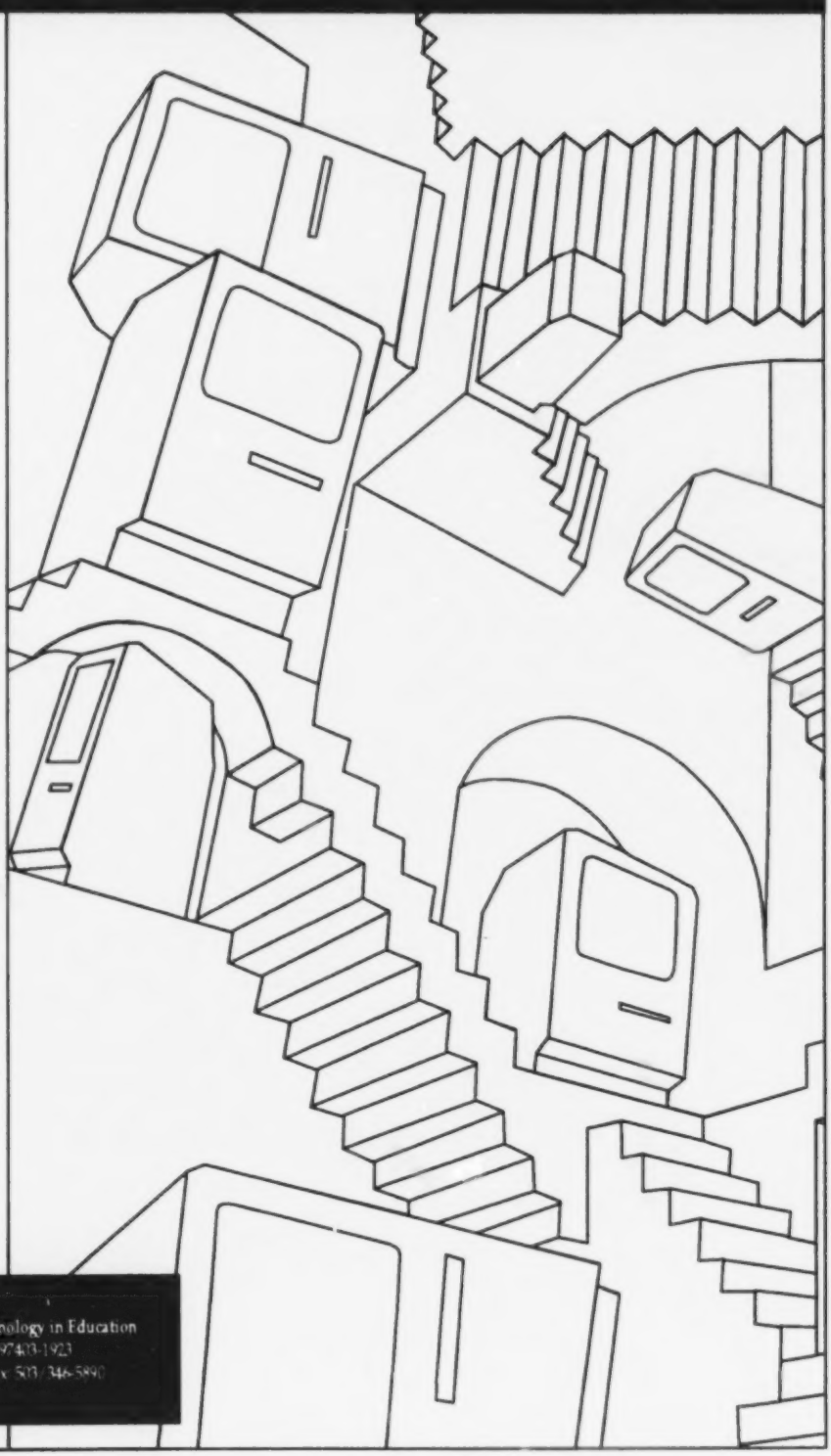

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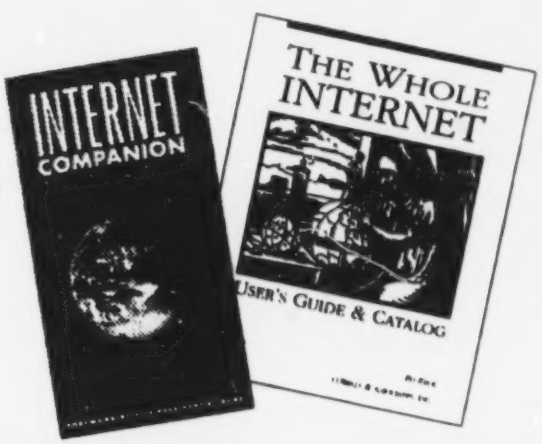


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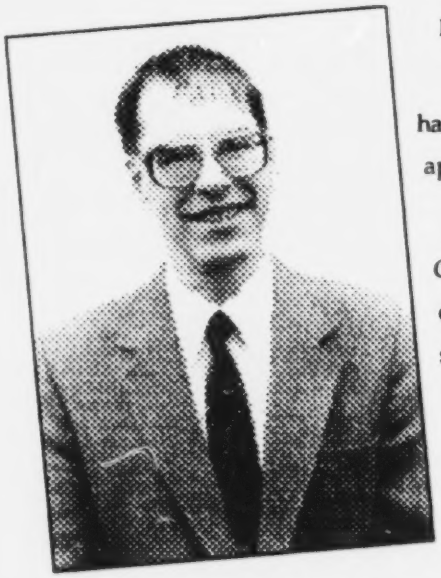
# Dave Moursund knows...



ISTE Executive Officer Dave Moursund is dedicated to improving education.

Since he first began working with computers in education in 1963, Dave has constantly sought to improve education at all levels through the use of appropriate computer-related technology.

As a continuing part of this effort, Dave's newest book—*The Technology Coordinator*—discusses the goals of education and how teachers and teachers of teachers can join in the enormous change process facing today's schools.

This book was written for educators who want to play a leadership role in the instructional use of technology. Dave uses interviews with technology coordinators to illustrate the needs, roles, and qualifications needed to accomplish the goals of educational technology.

In recent years, Dave has focused much of his writing efforts on problem solving and on staff development. Some of Dave's other books also available from ISTE include *Problem-Solving Models for Computer Literacy, LogoWriter for Educators: A Problem Solving Approach, Logo PLUS for Educators: A Problem Solving Approach* (co-authored with Sharon Yoder), and *Effective Inservice for Integrating Computer-as-Tool into the Curriculum.*

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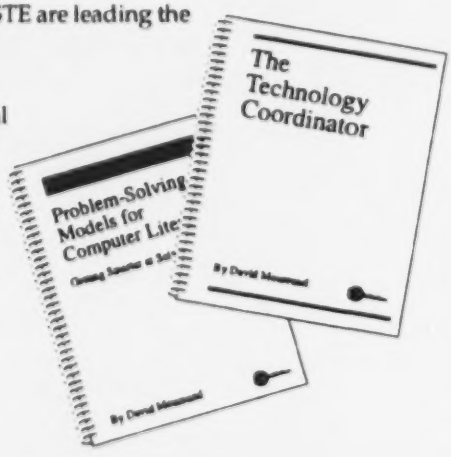


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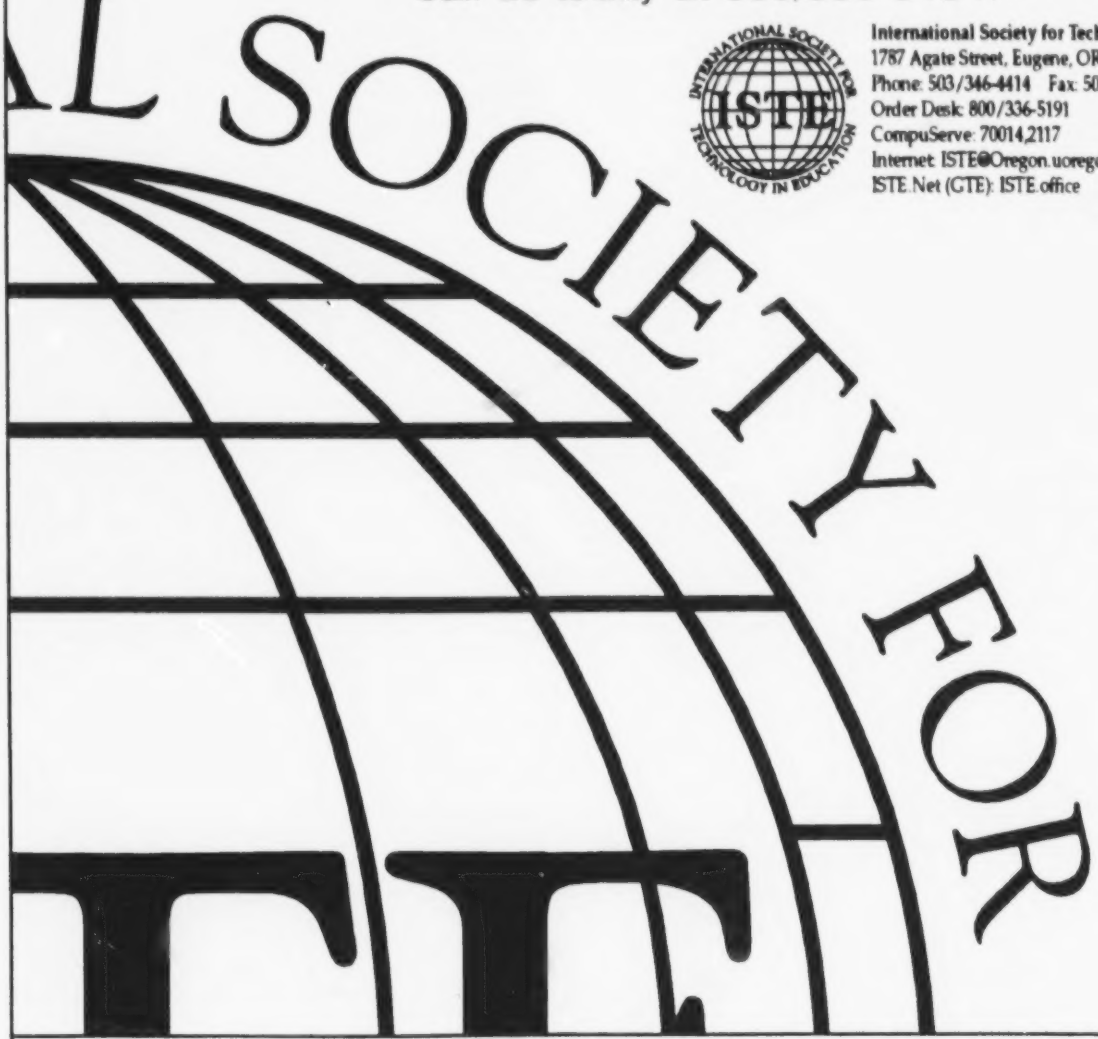


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